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Flash Illumination in Color Photomicrography*

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PART I

Ignition Flashlamps

MIDGET flashlamps were first used in color photomicrography by one of the present authors[1] as a tool for novices or microscopists who make color photomicrographs sporadically. The method concerned only simplified photomicrography utilizing a hand camera, but it has proved so satisfactory that we wish to extend it to professional photomicrography and describe some improvements on our original recommendations.

Original Problem

Color films are simple to use with illumination that is: (1) of the quality specified by the manufacturer, and (2) of an intensity allowing suitable exposure times for the specific film, usually a fraction of a second. These requirements offer difficulties to the photomicrographer whose equipment is limited. The light source most frequently used is a low-voltage incandescent lamp. With this type of lamp, the spectral quality of the light must be determined with a color-temperature meter and corrected if necessary. Moreover, exposure time, at least for high magnifications, may be so long that failure of the reciprocity law will lead to poor color balance and miscalculations of exposure for best overall density.

Arc lamps, e.g., the carbon or the zirconium arc, furnish reproducible light quality of adequately high level, but they are often inconvenient for the low and medium magnifications most commonly used in making color photomicrographs. The shutters furnished with many optical benches are too inaccurate for fractional-second times.

Proposed Methods (Advantages)

Miniature flashlamps overcome these problems in color photomicrography because: (1) they give a spectral quality of illumination proper for some color films, or can be easily corrected for others; (2) they give a relatively constant time of exposure, independent of the shutter, at the level for which most color films are balanced.

Proposed Methods (Disadvantages)

Most new methods introduce new problems. The problems arising from the use of miniature flashlamps in color photomicrography are not prohibitive. With open-flash exposures, it is necessary to bring the brightness of the image to that value which is correct for the combination of the particular film used and the duration of the flash. The problem has now shifted from that with incandescent lamps, i.e., from changing the *quality* of the illumination to that which

* Communication No. 1840 from the Kodak Research Laboratories. Presented at the 26th Annual Meeting of the Biological Photographic Association, Rochester, N. Y., August 30, 1956.

is correct, to changing its *intensity* to the correct level. As microscopists know, one cannot rely on manipulation of the condenser aperture to do this.

Flashlamps cannot be used directly for aligning the optical system nor for focusing the image and searching the fields. An incandescent lamp, serving as a control lamp, can be used. In this case, it must be possible to substitute one for the other, easily and quickly, and yet maintain good alignment and focus.

Another problem is that even miniature flashlamps are larger than the light sources normally selected for photomicrography so that much flare light can enter the imaging system very readily. Moreover, the observed area of a flashlamp is so uneven in brightness that it cannot be directly imaged in the field.

These difficulties will be considered in reverse order in the discussion of their practical solutions.

Use of Diaphragmed Diffusing Screens

The nonuniformity of illumination of flashlamps can be removed by placing a fine diffusing screen, such as a piece of matte film, directly in front of the lamp. This procedure also removes the defects in the image of the light source which are due to its volume and to the backward curvature of its front surface. This improves the light source even when it is being imaged in a condenser aperture by Köhler illumination instead of being imaged in the object field. The loss in illumination when the diffusing screen is close to the lamp is relatively little; there is about 80 per cent transmission of the illumination from the bare lamp with the diffuser at ⅛ inch distant and about 60 per cent when the screen is 1 inch away, as with our lamp.

A well-controlled diaphragm directly in front of the lamps and against the diffusing screen is important. This minimizes the problems of the large lamps, the chief of which is flare light. A sheet of brass, containing a hole about ½ inch in diameter and bearing a finely ground glass proved useful when the latter was imaged in the object field. An even more satisfactory arrangement is the use of a small iris diaphragm.*

Miniature Flashlamps

The midget flashlamp originally recommended[1] was the No. 5 or the corresponding No. 25, but these lamps are larger than is desirable for use with a compound microscope. Smaller ones are now available. These two flashlamps still would be preferable, however, for very low magnifications where a larger light source is an advantage.

Usually, the new M-2 flashlamps (7000-8000 lumen-seconds) will prove to be most useful for flash photomicrography. They are sufficiently small to allow their use directly behind a lamp condenser with no diaphragmed diffusion screen and utilizing Köhler illumination, if the condenser is of sufficient focal length (at least 60mm). However,

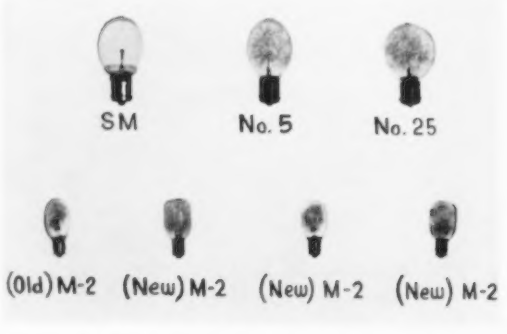

Figure 1. Five types of flashlamps suitable for color photomicrography.

* Such as Bausch and Lomb Co. Catalogue No. 31-58-28 or American Optical Company, Catalogue No. 354.

the use of a diaphragmed-diffusion screen is usually advantageous even with these lamps.

Some M-2 flashlamps are excellently aligned to their sockets, whereas others are not. This may make considerable difference when they are used in an optical system in photomicrography.

Four types of flashlamps that have proved useful in photomicrography are shown in Figure 1. As pointed out by Carlile[2], SM lamps are particularly useful for photomicrography of moving objects, although their relatively low brightness usually limits their use to bright-field illumination.

The relative photographic exposures (rated as intensity × time) of these four types of flashlamps are given in Table I. The values were obtained by photometry of the image plane of a photomicrographic bench set up for 400X magnification using an integrating photometer. Further details are given later in this paper. The method of illumination employed is denoted as Method (*a*) in the next section. Neither the specific magnification nor the method of illumination should make a great difference in the relative results obtained with the lamps. The photometer phototube is more blue sensitive than are color films but the excessive ultraviolet sensitivity was eliminated with a Kodak Wratten Filter No. 2B.

The third column in Table I gives the "probable error"; half of all lamps used would be expected to show a greater deviation from the average than this. Columns 4 and 5 give the maximum and minimum values of exposure found in a batch of ten lamps.

Methods of Illumination

It is assumed that the photomicrographer who decides to use flashlamps for color photomicrographs of stained slides does not make such pictures routinely and is therefore not equipped to make them readily with his regular microscope lamp. A relatively fast and simple illumination method is desirable in this case.

Method (a). With a relatively large uniform light source, a satisfactory method of illumination is simply to image it directly in the microscope field using only the substage condenser. With a fine-grained diffusing screen serving as a light source and an opaque diaphragm containing a hole only sufficiently large for its edges to be imaged within the field, this yields satisfactory results with any flashlamp and is by far the fastest and simplest method to set up and use. When the substage condenser is focused slightly up to throw the fine grain of

TABLE I

Flashlamps Useful in Photomicrography
Relative Exposures (I × t) and Reproducibility

Lamp	*Relative Exposure*	*re*	*Max.*	*Min.*
SM	20	± 1.3	23	16.5
No. 5	93	± 8.2	111	78
(Old) M-2	58	± 2.7	64	52
(New) M-2 (Mfr. A)	83	± 8.4	110	64
(New) M-2 (Mfr. B)	89	± 4.0	99	80
(New) M-2 (Mfr. C)	93	± 7.0	111	81

the diffusing screen out of focus in the field, this tends to project the image of the source (which is the screen) into the aperture plane of the objective. At high magnifications, this will tend to make the lamp diaphragm an aperture diaphragm. The optimum distance required between this screened source and the substage condenser to obtain the maximum exposure should be determined although this distance is not critical. With the equipment used for our exposures, this distance was about 25 cm.

Because of the brief duration of the flash, more flare light may enter the optical system with a dry objective by multiple reflection from behind the diaphragm than is realized unless special care is taken to prevent it. The microscope camera can be protected by adequate baffles and covers

Method (b). This same diaphragmed matte surface can be used with a lamp condenser to produce Köhler-type illumination, but in this case the hole in the diaphragm should be closed further to allow its image to just fill that of the substage diaphragm, or another sheet of metal with a different-sized hole should be chosen. The method is excellent and gives complete control of flare light.

Method (c). The advent of the M-2 flashlamp allows the flashlamps to be used behind a lamp condenser of at least 60mm focal length to give the usual type of Köhler illumination. In this way, at least twice the exposure (or image brightness) is produced as is obtained with a diaphragmed diffuser, with the latter about 1 inch from the bulb. It must be remembered, however, that these flashlamps are uncommonly large for photomicrographic light sources and that all flare light, due to this fact, will apparently add to the brightness of the image plane at the price of lowered image contrast.

A photometric comparison of these three methods of illumination is given in Table III of Part II of this paper.*

Although Method (*b*) is admittedly better, because of its limitation of the source size, Method (*a*) is so comparatively satisfactory that it may be difficult to distinguish any inferiority in the photomicrographs taken by this method.

These same principles apply to the simple as well as to the compound microscope. Here, however, a larger size of light source may be advantageous as the magnification of the subject decreases. Also, in low-power work, the optical arrangement shown in Figure 2 is best. The diaphragmed matte surface with either the flashlamps or the control lamp behind it would be substituted for the source, S, in the optical arrangement. This is equivalent to Method (*b*) used before.

The Control Lamp

An early suggestion for a continuously burning control lamp for midget flashlamps came from Carlile[2] who suggested the use of a No. 111 Photoenlarger Lamp as a control for the SM flashlamps to align and focus the optical system and the image. The suggestion was equally good for the No. 5 and the No. 25 flashlamps and we adopted it.[1] This control lamp furnishes about the same size light source as the flashlamps and fits into the same electrical socket. It is still suitable for these flashlamps except that it furnishes relatively low illumination in the image plane. We now wish to change the previous recom-

* At this point in the oral presentation of this paper, three color slides of a stained section of a human pituitary gland, X200, were shown that had been taken by these three methods, (*a*), (*b*) and (*c*), with a compound microscope. The quality of all three was quite satisfactory.

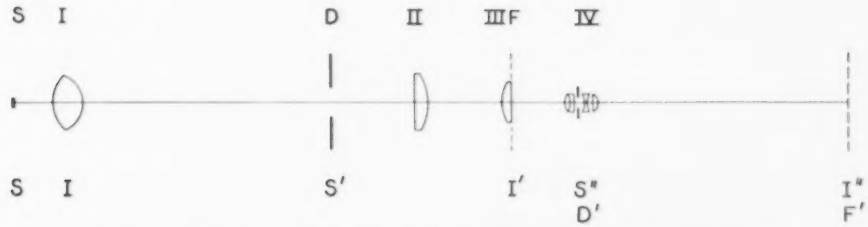

Figure 2. Optics of simple low-power microscope for photomicrography.

mendation to one of two projection lamps that also fit into the same sockets as the flashlamps but furnish a much brighter image on the screen of the camera. This is important if the image brightness is to be photometered for exposure determination. For our purpose, the lamps differ only in brightness, so that the choice may depend on the sensitivity of the photometer that is available. The higher-wattage lamp requires cooling by a blast of air. Either a fan or a rubber hose connected to a compressed aircock can be used. These projection lamps are:

1. 100-watt PH/100 T8-5C cc13 110-volt*
2. 300-watt PH/300 T8-1/2 5C cc13 120-volt**

Since individual control lamps may differ appreciably in the illumination furnished at the line voltage available, it is recommended that several spares be obtained and numbered and the ratio of the illumination furnished with respect to one of them be recorded.

Method of Using the Control Lamp

We now return to the discussion of solving some of the problems introduced with the method of using flashlamps. One of them was caused by the introduction of a control lamp which must be easily movable into the exact position to be occupied by the flashlamp or its optical equivalent.

There are four methods of accomplishing this:

1. Use of the same socket for both the control lamp and the flashlamp.
2. Use of a movable mirror to give optical equivalence of position.
3. Use of a horizontal slide allowing substitution of the position of two sockets.
4. Use of a rotating slide for this purpose.

1. *Use of the Same Socket.* Use of the same socket for both the control lamp and the flashlamp is by far the simplest system to set up and hence was the first one to be used. It is not the fastest nor the simplest to use, between the focusing of an image or its exposure determination and the flash exposure, but it is a practical method and [illegible] with which we have made satisfactory photomicrographs. In the apparatus shown in Figure 3, extra light shields in front of the lamp and diaphragm have been removed because they obscured details. Such shields, which may be of cardboard, should be used. In this equipment, the lamp socket and diaphragmed matte surface can be slid to one side as a unit in favor of the lamp used for prolonged visual work. The 100-watt lamp is in the socket but the 300-watt lamp could be substituted as the control lamp. Some *important* precautions with this method

* Used by American Optical Co. in No. 735 microscope illuminator.
** Used in Kodak Brownie Movie Projectors.

Figure 3. Apparatus for substitution method in flash photomicrography.

are necessitated by the fact that two lamps requiring two different voltages are used in the same socket. A double-pole, double-throw switch should be used between the two electrical sources (a 115-volt line and a battery) with an extra pushbutton in the battery line that must be operated to flash the lamp. If the neon lamp is connected across the 110-volt side to indicate when it is "alive," the total circuit is not likely to allow either type of lamp to be lighted while it is being inserted in its socket.

2. *Use of a Mirror.* A mirror may be slipped into the axis of the illumination beam of a control lamp that will bring the previously aligned and focused beam from a flashlamp into the same axis. The aligning and focusing is done by the previous substitution method, used temporarily. The method is much faster and simpler, and we expect to continue to use it for some of our work. To be satisfactory, the mirror must move in and out of the beam easily and with very accurate reproducibility, since deviations of angle are multiplied by two. Figure 4 shows a swing-out mirror which has two relatively large (1-inch) precision ball bearings on each side of the 2½-inch mirror. Such bearings can be purchased. A first-surface aluminum mirror, protected by silicon monoxide, is suitable and is commercially available.* The common aluminum mirrors protected by chromium must be avoided.

3. *Use of a Horizontal Slide.* The device that is simplest and fastest in use and also is stable in alignment between the flashlamp and the control lamp is probably one in which a socket for each lamp can be moved into an identical position. This is the system usually chosen for commercial electronic flash

* Evaporated Films Inc., Ithaca, New York.

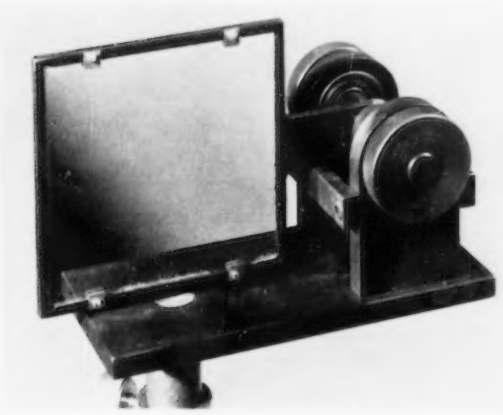

Figure 4. Swivel mirror.

lamphouses that are especially built for photomicrography. The slide carrying the two lamps can be on a carriage bar sliding horizontally between a stop at each end. This is probably the arrangement that requires less skill and fewer shop facilities to make than does a rotating slide, but is bulkier.

4. *Use of a Rotating Slide.* A slide carrying the two sockets that rotates into the two positions makes a more compact lamphouse and also a more convenient one, especially if a toggle is used to keep the slide at either of the two positions. Such a lamp may require a reasonably skilled shop if it is to be accurate and remain stable. However, we chose this type which is shown in Figure 5, and it has proved very satisfactory. The outside housing has been removed for the picture. The exact position of each lamp is controlled by a locked bolt at the end of the motion in each direction, with the toggle spring pressing the slide against it.

Modulation of Illumination Intensity

As already mentioned, flash photomicrography requires that the illumination beam be modulated to give the correct photographic exposure for the film in use and to accommodate the exposure time set by "open flash" of the lamp. An excellent shutter synchronized with the flashlamp and placed in the proper aperture plane of the optical bench can be used to alter time as a variable below that of open flash, but this is not a good general solution. When a matte film diffuser is used in front of the lamp, the intensity of illumination can be reduced by piling up separated pieces of matte film, with the diaphragm in front of the last piece.

A more general solution became possible with the introduction of Inconel neutral densities which consist of a metallic alloy evaporated on squares of glass. The light not transmitted by a density is reflected by the mirror so that such densities cannot be piled up to give a quantitatively additive density as can the neutral densities based on absorption. However, they can be obtained from manufacturers of microscopes and optical

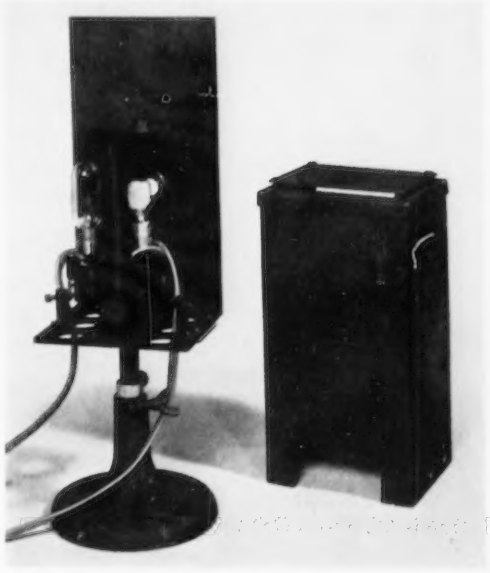

Figure 5. Flash lamphouse with flashlamp and 100-watt control lamp.

supplies in a density range from 0.3-1.2, 0.15 being available on special order. These densities can be spectrally neutral, including the region beyond the visible range, and then are as good photographically as visually. On the other hand, in commercial practice, they may impart a hue shift to the balance that is greater than is acceptable. This will be due to a very small and broad spectral absorption that can be compensated, for this purpose, by binding a weak Kodak Color Compensating Filter of appropriate hue permanently to an Inconel filter.

An appreciable lack of photographic neutrality in an Inconel density can be detected by visual observation, especially if compared with a good visual neutral, such as a Kodak Wratten Neutral Filter. It can also be tested by employing the iris diaphragm as an alternative method of modulating the light. Unfortunately, unless an excellent achromatic lamp and a substage condenser are used, considerable modulation of the light by the diaphragm also affects the color balance, at least over a factor of about 4X. However, it can still be used to compare a dense Inconel density with a lighter one.

Determination of Exposure

The exposure level, including the proper modulation of the illumination to bring it to the correct value for the flashlamp, can be determined photographically with repeated use of flashlamps and Kodak Super-Speed Direct Positive Paper. Although this may be useful sometimes as a calibration method, it nullifies the simplicity and other advantages of this method. To be a practical method, the exposure level should be set with a photometer, preferably one measuring the illuminance in the image plane. As discussed elsewhere[3] for reversal color films, it is usually best to rack the specimen out of the field in photometering it.

If a photometer is available that is adequate to measure the illumination in the image plane, *with the control lamp on the axis,* the procedure for photomicrography by bright-field illumination is very simple. The illumination value (illuminance) is brought to the value that is correct for the film, by modulation of the illumination beam. The flashlamp is then brought into the axis and fired. If a photometric or color-balancing filter is used, it should be placed in the beam with both lamps.

The correct value of the photometer reading for satisfactory exposure of color films can be found on a purely relative, empirical basis by photographic tests. Some values of the optimum illuminance in the image plane in foot-candle-seconds are given in Table II for the two control lamps recommended and for several color films. Since the photometry is done using the control lamp but the photography is done with another lamp, i.e., a flashlamp, the values in Table II do not have the reliability of the E_c values previously published[1,3] which were obtained and are used in cases where the illuminance of the image plane is measured and the film is then put into this illumination and plane. This defect shows up in comparing the photometry of the control lamp for a flash with and without diffusion in front of the lamps. Because of the different sizes of the lamps and some intervening distance, the value for optimum exposure is somewhat different between the two cases. On the other hand, although these are values of illuminance in foot-candles, taken with a barrier-layer cell photometer, the fact that the exposure time is constant for a given flashlamp causes these values to function as exposure values ($E=I\times t$) similar to E_c, where a smaller value represents a faster film. Like E_c, the use of these values to determine exposure

TABLE II

Illuminance (Foot-Candles) in Film Plane from Control Lamp For Satisfactory Exposure with Flashlamps

			Control Lamp Illuminance at 117 Volts			
			Methods (a) and (b)			*Method (c)*
Flashlamp	*Film*	*Type*	*100-watt*	*300-watt*	*No. 111 Enlarger*	*300-watt*
M-2	Kodachrome	F	0.12	0.36		0.45
M-2	Kodachrome	A	0.12	0.36		0.45
M-2	Ektachrome	F	0.06	0.18		0.22
M-2	Ektachrome	B	0.15	0.40		0.50
No. 5	Kodachrome	F			0.012	
No. 5	Ektachrome	F			0.006	

should give the exposure value that will *just* not burn out delicate detail against a background. For darker subjects or thicker sections, the exposure time should be increased, usually not as much as by a factor of 4.0X.

Photoelectric photometers for determination of exposure in the image plane have been discussed elsewhere[1,3]. Commercial photometers, sufficiently sensitive for this purpose are available commercially or can be constructed as previously described.

The following experience with exposure determination may prove to be of practical value: when making an exposure of a specimen by polarized light, we found that if the illumination were read with the control lamp and with the polarizing and analyzing filters, such as Polascreens, parallel to each other, satisfactory pictures were obtained with them crossed when the illumination was increased by a factor of *four* over that correct for the parallel position of the polarizers. This will certainly depend upon the specimen to some extent and can always be checked by a trial using Super-Speed Direct Positive Paper[3]

PART II

Electronic Flashlamps

Electronic flashtubes are also included in the type of lamp that can be depended upon for a reproducible quality of illumination in independent laboratories. Hence these flashlamps are also adaptable for color photography. Although one of these lamps probably would not be purchased expressly for making color photomicrographs, because of the expense involved, if there is one already available, it should prove useful for the purpose. However, an electronic flashlamp will usually be obtained in order to make still or motion pictures of moving image. This motion may be due to motion in the specimen or to the vibration of the equipment. The latter point will not be discussed further except to state that this is one method of solution that has been used.

Characteristics of Tubes, Optimum for Photomicrography

Low-voltage xenon flashtubes, i.e., of 1000 volts or less, are preferable in order to keep the exposure time not appreci

ably less than 0.001 second. This will minimize the problem of lack of color balance and photographic speed which are due to the common photographic defect of the failure of films to observe the reciprocity law, $E = I/t$. The range of 0.002-0.001 second is usually adequate to stop motion of the image, although the latter is a function of several factors and increases in speed and amplitude proportionally to the magnification.

A compact arc of relatively short length is desirable because it can be imaged more easily into the small, round aperture of the microscope substage. Moreover, its most important application is probably in making photomicrographs of living microorganisms or of suspended particles that are illuminated by a phase or dark-field condenser. This means that the flash illuminant must be imaged in an annular aperture. A very poor flashlamp for this purpose would be one that gave a very bright spot at the center of its image but diminished in brightness from there outwards.

The lamp efficiency is very important. The nominal watt-second rating of a lamp is a very poor guide for the illumination provided through an optical system. It will be noted that even the exposure guide numbers for use with reflectors for ordinary flash photography are not proportional to the watt-second ratings. After a search and some trials among the lamps commercially available, we chose the G.E. FT114* and the G.E. FT218 Flashtubes as being most suitable for use in photomicrography. There are a number of variants of this last type, all made by the same manufacturer, but they are not fundamentally different. The FT218 is larger than the FT114 and, with its high efficiency, furnishes more light into the optical system (see Table III). Moreover, each of these two lamps may be utilized at an appreciably higher watt-second input than is commercially quoted as normal for them, with considerable gain in image illumination and without too serious a loss of lamp life for purposes of still photomicrography. This may mean obtaining high-magnification, dark-field pictures not otherwise possible, and the total number of firings may not equal those of a news photographer.

Lamps

About 1950 we utilized the FT114 Flashtube for photomicrography by constructing the electronic gear for it according to a modification of the circuit of the General Electric Co., but sending more energy through it than its normal rating. The intention was to almost double the energy used from the 100 watt-second rating but, with the commercial parts used, we found the measured input was about 120 watt-seconds. We have found no marked loss of life of the tube and consider that any loss of life at 200-250 watt-seconds with the lamp would be worth the gain when required. Actually, the full capacity need not be cut into the circuit except when needed. With the present load, this lamp has a practical duration of flash about 1/1000 second and furnishes sufficient illumination for photography at high magnification with phase illumination and high-speed film. Figure 6 is a photomicrograph of living organisms from the mouth which was made with this flashtube at 1000X magnification, using bright-phase (A+) illumination with a Kodak Wratten B Filter on Kodak Super-XX Film.

Utilizing experience with this lamp, a special lamp (Ascor FT221) incorpor-

*FT114 no longer available. The FT110 is the electrical equivalent, the difference is in the socket construction.

TABLE III

Photometric Comparison of Flashlamps and Methods of Illumination
(Kodak Wratten 2B Filter in the Beam)

Item	*Light Source*	*Conditions*	*Time in Seconds*	*Illumination Arrangement*	*Meter Reading (Exposure)*
1	SM		0.005	(a) Diaphragmed dif.	20
2	No. 5		0.02	(a) Diaphragmed dif.	93
3	No. 5		0.02	(b) Diaphr. dif. + cond.	67
4	Old M-2		0.01	(a) Diaphragmed dif.	58
5	Old M-2		0.01	(b) Diaphr. dif. + cond.	48
6	Old M-2		0.01	(c) Köhler	106
7	New M-2		0.01	(a) Diaphragmed dif.	89
8	New M-2		0.01	(b) Diaphr. dif. + cond.	71
9	New M-2		0.01	(c) Köhler	155
10	FT114	120 watt-sec	0.001	(b) Diaphr. dif. + cond.	105
11	FT114	120 watt-sec	0.001	(c) Köhler	280
12	Ascor	300 watt-sec	0.002	(b) Diaphr. dif. + cond.	174
13	Ascor	300 watt-sec	0.002	(c) Köhler	460
		Control Lamps			
14	100-watt	110 volts	0.01	(a) Diaphragmed dif.	
15	100-watt	110 volts	0.01	(b) Diaphr. dif. + cond.	0.9
16	100-watt	110 volts	0.01	(c) Köhler	3
17	100-watt	120 volts	0.01	(a) Diaphragmed dif.	2
18	100-watt	120 volts	0.01	(b) Diaphr. dif. + cond.	0.7
19	100-watt	120 volts	0.01	(c) Köhler	2
20	300-watt	120 volts	0.01	(a) Diaphragmed dif.	
21	300-watt	120 volts	0.01	(b) Diaphr. dif. + cond.	3
22	300-watt	120 volts	0.01	(c) Köhler	8
23	G.E. 1085	56 watts	0.01	(c) Köhler	6
	Coil fila.	16.5 amps			

ating the equivalent of the FT218 Flashtube was designed in cooperation with Mr. Harry Parker of the American Speed Lamp Co. The 56-231 Power Supply used with this lamp operates at 480 volts maximum, has a supply voltage of 117 volts, and utilizes 300 watt-second. When two of the central units of the tube. It furnishes less than the light in the image plane of the photomicrographic camera as does the FT114, when both lamps are bare, and about three times as much when a diffusion screen is used (Figure 7). This is because it is larger. This lamp can be used with dark-field illumination and a high-speed film but not at the highest magnifications with low-contrast subjects so still more light could be used. Figure 8 shows the Power Supply, camera, and mount, with the lamp adjusted for a magnification of X. A Kodak Wratten 47 Filter and Kodak Royal Pan Film. This lamp d

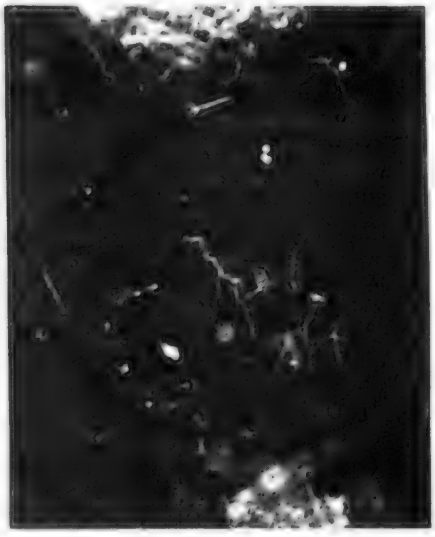

Figure 6. Motile bacteria from a normal mouth: 1000×; bright-phase illumination; G.E. FT114 Flashtube.

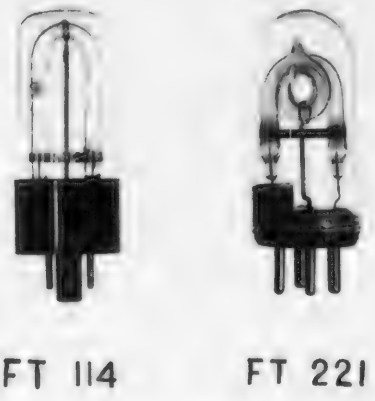

Figure 7. FT114 and FT221 (Ascor) Flashlamps.

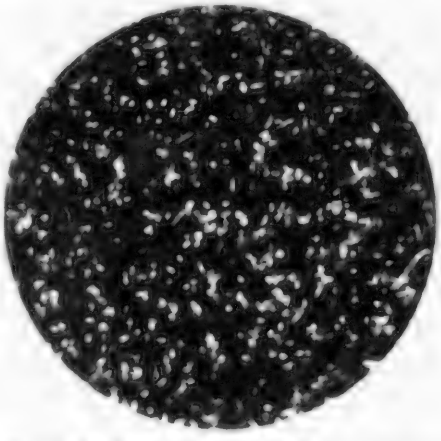

Figure 8. Motile bacteria, *Pseudomonas fluorescens*: 500×, dark-field illumination; Kodak Wratten G Filter; G.E. FT221 Flashtube.

not have a range switch whereby extra capacity could be added to increase the watt-second power for photomicrographs requiring especially high illumination. Such a switch would be worth while.

Methods and Equipment

The general methods of use are the same as those for flashlamps and were discussed in Part I, except that the same socket cannot be used for both the control and the flashlamps. However, the simplest, easiest method is still alternating the control lamp and the flashlamps behind a diaphragmed diffusing surface. Since this method, as discussed in Part I, is the best one for a large light source, it is especially adaptable to the coiled glass tube of a xenon flashlamp. Without the diffuser, it seems to be best to image only a section of the tube into the condenser aperture.

Special care must be taken by those who are not specialists in using this type of electronic apparatus, because the combination of high voltage and high capacitance is dangerous to the operator or to a casual visitor. A potentially fatal shock can be given by such equipment after it is turned off, *unless* provision is incorporated in the shutoff switch to short all capacitors. All live terminals, such as those attached to a voltmeter, should be protected because the lamp may be

used in semidarkness. There may be special danger to some people, such as TV technicians, who are used to working with even higher voltages but lower capacitance.

If a special xenon flashlamp is obtained for photomicrography, adequate and permanent auxiliary equipment for using it is justified. Bringing the beam from the flashlamp into the microscope axis by a swinging mirror has been discussed. It is a practical, successful method. It is not as easy to bring the beam accurately into the axis this way, as is an arrangement which allows a control lamp and a flashlamp to swing or slide into the same position. Figure 9 shows the arrangement for blowing compressed air onto the 300-watt control lamp.

Another method was tried that was briefly mentioned by one of the authors at a previous BPA meeting and also in the German literature. This consisted in making a mirror of the entire external glass bulb of the flashtube except for a small window, possibly 1/4 inch in diameter. It was hoped that this would control glare by making the flashbulb the equivalent of a small light source and would conserve light by functioning as a specially efficient integrating sphere. However, the method has not lived up to its promise. The vapor of the flashtube absorbs its own light. The method is therefore no more efficient than the use of the diaphragmed diffuser previously described, and this mirror is more trouble to prepare.

Figure 9. Lamphouse with Ascor Speedlamp in position and 300-watt control lamp

Aligning and Focusing Problems

The problem of aligning and focusing the flashtube into the optical system of the microscope still exists when the control lamp is used because the former must be set up well in the first place. Moreover, the control lamp and the flashlamps may get out of alignment with each other over extended intervals of time.

A simple expedient for checking alignment is to focus a bright light onto the flashtube and to use the light reflected from the tube walls as a source with which to observe through the optical system from its rear.

A practical method for setting up the optical system or installing the flashlamp is that which uses a plate or film carrying a persistent phosphor. For instance, if it is placed at the substage aperture, the persistence of the image of the flashlamp can be used to ensure both centration of the image and its optimum focal position. The bright image can be quenched by holding it briefly in a near

by beam of infrared radiation; e.g., near a desk lamp with a Kodak Wratten Filter No. 87 over it.

Continuous, Low-Power Flashing of Xenon Flashtubes

If the illumination from the flashtube could be made visually continuous, it could be aligned and focused as readily as could any incandescent source. Continuous flashing of xenon tubes at relatively high frequency and high power has been applied in photography but it involved very short bursts or short tube life and usually bulky power supplies. Repetitive flashing at very low power and with a very low frequency, such as 10 flashes per second, was found to be a practical method of accomplishing the purpose. The flicker that is observed at such a frequency is inconsequential. Even the microscope image can usually be focused in the camera with this illumination, yet there should be little effect on the life of the flashlamp because there is negligible heating of it. There is appreciable luminescence from a single flash at normal power. There should be little or no cathode damage since recommended voltages are used.

This low-power repetitive flashing was first used (October, 1955) by the author with the FT114 lamp with a frequency of 20 flashes per second at 0.05 watt second per flash. Originally, a separate circuit was constructed to maintain the auxiliary flashing, the trigger pulse being generated by a mechanical interrupter. However, the use of an OA trigger tube, in a relaxation oscillator circuit, was found to be more compact and convenient and the circuit easily incorporated in the equipment.

When the special Ascor Speed Light was obtained, this feature of low-power, low-frequency repetitive flashing was incorporated, and it has proved its convenience. Jarrett[4] mentions the use of repetitive flashing of a mercury-argon flashtube at 1/10 joule to align the optical system where the flash is ultimately to be used for a motion-picture sequence.

The appearance of the low-power flash was rather unexpected. Instead of a very faint glow filling the entire tube, a very intense, very thin spark, which followed the trigger winding on the tube somewhat erratically, was observed. It was noted that the diameter of this spark varied as the capacitance of the power supply changed. This thin spark was excellent for focusing the tube but only fairly good for alignment. However, by using a semidarkened room, it was found that there was a distinct glow from the walls of the tube that could be seen in the image of the source and which made accurate centration very simple.

Another feature, that is very useful in flash photomicrography, was added. The total capacity of the power supply was subdivided into a series of capacitors that could be cumulatively added into the circuit. With this device, it becomes possible to have a greater overloading of the tube than would be wise for routine flashing in order to achieve higher exposure for exceptional requirements such as dark-field, normal loading for medium-power phase contrast, and considerable underloading for low-power, bright-field photomicrography where otherwise high modulating densities in the light beam would be required. Moreover, the exposure requirements of each situation within the available power range can be met without the use of optical modulation. Actually, stepless electrical modulation of the flash exposure is available by using the selector switch for coarse adjustments and the voltage adjusting rheostat (in the primary of

the power transformer) as a fine adjustment. By varying the voltage on the capacitors between 600 and 900 volts, a power variation between 18 and 200 watt-seconds is obtained. The power can be determined by the equation,

$$\text{watt-seconds} = \tfrac{1}{2}\ CV^2,$$

where C is the capacitance in microfarad and V is the voltage in kilovolts.

The reduction of capacity to reduce the exposure instead of the use of densities has the further virtue that the duration of the flash is reduced which may be advantageous in stopping motion under the microscope.

The instrument is shown in Figure 10a and the circuit in Figure 10b. The customary voltage doubler is used. The repetitive flash portion of the circuit utilizes a pair of 2.5-microfarad capacitors reducing the power of each flash almost 2000 times below normal rating. Component layout is not critical. The entire power supply was easily assembled on a 10- by 17- by 9-inch amplifier foundation unit, although a smaller unit could have been used. In the authors' unit, the trigger coil, T_{R1}, was mounted on the chassis rather than at the preferable flashtube socket location without any noticeable ill effects. High-voltage cable, of course, was used between the coil and the trigger conductor on the flashtube. The capacitor discharge relays automatically close and rapidly discharge the capacitors

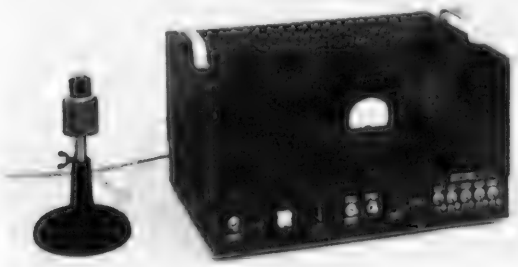

Figure 10a. FT114 Flashtube and special power supply for photomicrography

CIRCUIT FOR FT114 XENON FLASH WITH VARIABLE POWER AND REPETITIVE FLASHING

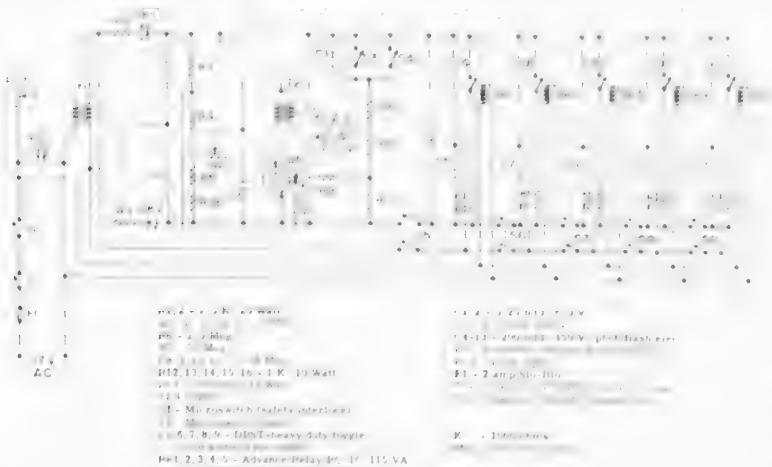

Figure 10b. Circuit for power supply for use of FT114 Flashtube in photomicrography

when power to the unit is interrupted. This important safety feature should not be omitted; without it, the capacitors might retain a lethal charge for a considerable period of time. No high-voltage terminals should be left exposed where a person might accidentally make contact with them. It is advisable to turn the power switch off before changing the position of any of the selector switches to avoid arcing and premature failure of the switches.

The setting of potentiometer R_6 controls the frequency of the repetitive flashing. The lamp can be operated for an appreciable period of time at mid frequency without damage; for those few instances where the maximum frequency may be desired, it is suggested that the lamp be operated for no more than 30 seconds out of each minute.

Photometric Comparisons

All of the flashlamps considered were intercompared photometrically. This was done by the same method used for the photometric comparison of all of the important light sources used for photomicrography that were made and discussed[5] by the present authors in 1954 and also the method used to obtain the values of Table I. The value measured was the illumination in the image plane of the photomicrographic camera, set up for 400X magnification, as integrated over a time interval by the General Radio Light Meter; the light in the image plane during the open flash was collected and measured to give a meter reading that was proportional to *intensity* × *time*, i.e., to photographic exposure. This method also allows a comparison of flashlamps with continuous sources by using the latter with a shutter of 100 percent efficiency, such as a sector wheel. The count value during 1/100 second was used. The values obtained in the resultant table (Table III) should be representative of those obtained when these lamps are used for photomicrography with the compound microscope and illumination of the same type but different optics and magnifications. Each lamp was used at the distances and the lamp apertures that gave equivalent size of the illumination field and the aperture in the microscope. This arrangement will *not* produce values that are easily correlated with normal visual "brightness ratings" of bare lamps, which are usually quoted. The optical arrangement used for the tests is as follows:

Method of Illumination: (*a*), (*b*), or (*c*) as described.

Lamp Condenser: Methods (*b*) and (*c*); 62mm, f 1.5 achromat.

Substage Condenser: Zeiss Achromatic, N.A. 1.0.

Objective: Bausch and Lomb 4mm apochromat filled to N.A. 0.85.

Oculars: Zeiss Compensating 6X.

The values for use with Method (*b*) may be considered somewhat arbitrary since they will vary with the diaphragm aperture in front of the diffuser. In the cases used for these measurements, the diaphragm was set so that its image just filled the aperture of the substage condenser.

With the variable power available through a series of capacitors, it was found that the exposure varied with the watt-second input (above 40 watt-seconds), according to the equation,

$$\text{Exposure} = 2.67\ (\text{watt-seconds}) - 40.$$

Therefore, the values given in items 10 and 11 of Table III can be used to calculate relative exposures corresponding to other power inputs. In the case of the unit made in these Laboratories, the relative exposure for illumination Method (*c*) varied from 25 units at 18 watt seconds to 490 at 200 watt-seconds.

Values for the control lamps ranging below 5, are not very accurate with the meter that is used but may be of significant help in giving a perspective of the illumination values involved, and of practical help, along with Table II, in estimating exposure where there is no previous experience but when a photometric reading of illuminance is available

Applications

1. To color photomicrography. The quality of the illumination from the xenon flash is satisfactory for use with color films made for daylight illumination. It is used this way in the studio We found that, when color compensation was required on a photomicrographic bench with color films for tungsten light using illumination correct for the film at the lamp, the same color-compensating filters also gave excellent results* when a xenon flashlamp was used with daylight-type color film. The compensation for the effect of abnormally short exposure on the color balance is furnished in the boxes of Kodak Professional Color Films.

2. To stop motion. The xenon flashlamps described furnish sufficient illumination for photomicrography by bright-field illumination at almost any magnification, but most cases, where the flash is used to obtain still pictures of a moving specimen, will require either phase illumination or dark-field illumination, and both of these types are wasteful of light

The two most common types of specimens with inherent motion, of which still photomicrographs in natural condition might be desired, are: (a) liquid suspensions of small drops of particles in Brownian motion: and (b) motile living organisms

Samples of suspensions of drops or particles exhibiting Brownian motion are common in industrial practice. The simple use of an M-2 flashlamp as described in Part I may be sufficient for the purpose. The sample in Figure 11 was homogenized milk taken at a magnification of 1000X on the Kodak Royal Pan Film, and (A^-) dark-phase illumination with Method (*c*) (no diffusion) arrangement of optics. A Kodak Wratten B Filter was used. In Table III, items 9 versus 11 or 13 will show that the M-2 flashlamp will probably have sufficient light for this purpose if the xenon flash tube is satisfactory: the latter furnishes only about twice as much light. The choice will probably lie in the limitation of exposure duration to "stop" the motion. The M-2 flashlamp has one effective exposure time of 0.01 second; the duration of FT114 Flashtube is one-tenth as long. The velocity of all motion in the field of a microscope is multiplied by the *magnification* of the image. The velocity of the particles in Brownian motion i

Figure 11. Homogenized milk *particles* in Brownian motion: 1000 ×; dark-phase illumination; Kodak Wratten B Filter; M-2 Flashtube.

* A [illegible] photomicrograph of *Euglena gracilis* [illegible] with the FT114 Flashtube was shown as a [illegible] slide at this point during the oral presentation of this paper

proportional to *temperature* and the *mass* of the particles. We have cooled a sample to the point where the better definition was obtained in a photomicrograph made with a flashlamp. However, with small particles and high magnification, the FT114 xenon flashtube or its equivalent may be required to obtain sharp images of the vibrating particles. This is illustrated by Figure 12, which shows a dispersion of oil droplets used in Kodacolor-type photographic films and was made at 1000X magnification with the FT114 Flashtube, (A^-) dark-phase illumination, and a Kodak Wratten B Filter.

Dark-field illumination requires about 50 times more light from the lamp than does phase illumination at the same magnification.[5] The fact that, even with the Ascor unit, illumination is just adequate for photomicrography of this through a yellow filter at high magnification has already been discussed and illustrated.

However, all dark-field photomicrography of rapidly moving organisms does not require such high magnification. To illustrate this, a flash picture was made* of a single living paramecium at a magnification of 500X. Rheinberg type illumination was used. The substage condenser (achromatic) of 1.4 N.A. was used with an 8mm apochromatic objective of 0.65 N.A. The filters were cut from Kodak Wratten gelatin filter film with an overlap of about ½mm between the two color filters and the composite disk laid in the filter holder in the rear focal plane of the condenser. The central disk just covering the aperture cone of the objective was made of Kodak Wratten Filter No. 49. The rest of the condenser aperture was filled with light coming through the annular Kodak Wratten Filter No. 15. Water immersion was used to increase the yellow exposure. Thus, the organism appeared as bright yellow on a deep blue background; Kodak Ektachrome Film, Daylight Type, was used.

In making flash photomicrographs of living organisms when some field selection must be made, as when photographing a single moving organism, it is practically essential that it be possible to observe the whole field up to the moment of flashing, and it is a great advantage to be able to observe a larger field than is photographed. The best way is probably that of using an observation eyepiece above the ocular that sends the image beam from the microscope to a side tube for visual observation, by means of a mirror or prism that is flipped out of the way just before the flashtube is operated and by the same mechanical impulse. Such a device is incorporated in some of the commercial photomicrographic stands that have provision for flash photography.

The following improvisation was successful in making the flash picture of the

Figure 12. Oil droplets in water: 1000×; dark-phase illumination; Kodak Wratten B Filter; FT114 Flashtube.

* This was shown from a 3¼- by 4-inch color slide during the paper presented before the meeting.

paramecium mentioned and may help others to obtain flash photomicrographs of motile organisms. The split-beam box of a vertical illuminator containing a cover glass-type reflector at 45 degrees was inserted above the microscope objective and the drawtube of the microscope was correspondingly shortened. The principal beam from the microscope reached the photographic film (Ektachrome Film, Daylight Type) as usual. A brass tube, of a size to hold a microscope ocular, was held horizontally so as to include the horizontal beam from the vertical illuminator. A micrometer ocular with focusing eye-lens was used in the outer end of this tube and the eye-lens was focused on the micrometer scale. The whole tube was carefully adjusted at such distance as to bring the image simultaneously into focus visually at the scale and on the film.

The beam from an incandescent lamp (the control lamp) was brought into the optical axis of the microscope from the side by means of a clear glass mirror set at 45 degrees to the illumination axis; the beam from the flashlamp came straight through without appreciable loss. The light from the control lamp was modulated by a Variac. When the exposure was taken with the flashlamp, using a flash shutter to protect the film, the effect of the continuously burning incandescent lamp was not noticeable.

Summary

Flashlamps are among the types of lamp which independently furnish a specified and desirable quality of illumination illuminating the [illegible] required of the more usual low-voltage incandescent lamps. Moreover, flashlamps are still limiting in exposure time at a level to obtain the optimum exposure characteristics with modern color film whereas camera shutters on most photomicrographic benches are notoriously poor at this level. They are therefore a useful light source for color photomicrography of slides, especially for photomicrographers not routinely engaged in color photomicrography or for those with limited equipment. The miniature flashlamps, particularly the new M-2, are especially valuable. The optical and apparatus alignments are relatively simple, a continuously burning control lamp being used. A very simple, yet usually satisfactory method consists in placing the flashlamp and/or its control lamp directly behind a diaphragmed diffusing screen.

When used to stop motion of specimens with a compound microscope, phase or dark field illumination is usually required also, to give sufficient contrast to living protoplasms or small particles in Brownian motion. With high magnifications very short exposure times are required. The new M-2 lamps are sometimes applicable in this case but a xenon flashlamp may be required. Two types specially suitable for photomicrography are considered. The techniques for aligning and focusing flashlamps are discussed. A [illegible] useful for continuous flashing at very low power is specially convenient. A photometric comparison of the suitable flashlamps is given with the several alternative methods of use.

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Recent Progress in Open-Tube Endoscopic and Cavity Still and Motion Picture Photography*

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Introduction

In general, medical endoscopic photography is the process of taking still or motion pictures of small areas within the living human body. Most work today is done in color. The photography is done through endoscopes, specula, or directly into natural or surgical cavities. These methods also are of value in research laboratory animal work.

The word "endoscopic" is derived from the Greek word-roots *endon* and *skopos*, and literally means "to see inside". The usual definition of "endoscopic photography" in the medical field is "photography through an endoscope". But from the photographic standpoint, endoscopic photography may be described as "photography with coaxial shadow-free lighting" (Figure 1). Since coaxial lighting is required for the majority of endoscopic areas, the term should include cavity and speculum work.

Need for Endoscopic Photography. A study of the uses of endoscopic photography in medical education and research helps to show the need for the *total process* of endoscopic photography and the fundamental importance of the Class 1, hand held, still or motion picture camera provided with coaxial lighting.

Endoscopic photography is a partial solution to the general problem of showing details of small fields in living patients to a group of doctors and students for discussing specific cases, surgical techniques, pathology and treatment. Direct viewing through endoscopes is not practical because only one person at a time can look through an instrument, and examinations cannot be interrupted repeatedly for periods of time sufficient for each student to examine and understand all points of interest. Often there are not enough typical cases on hand for teaching. Visual records are needed to reduce the time demanded of the student and instructor, and to provide records to show progressive steps in surgery or treatment. It is apparent, then, that endoscopic photography is a most important tool in medical education and research.

The three key contributions that endoscopic photography provide are: memory, magnification, and duplication.

* Presented at the 26th Annual Meeting, Rochester, New York, August, 1956.

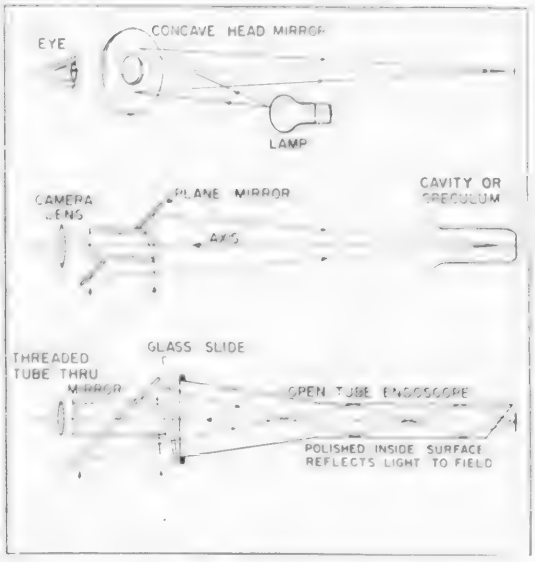

Figure 1. Examples of Coaxial Illumination.

Memory is provided in the photographic record.

Magnification is provided optically so that fine details of small fields are easily seen.

Duplication is provided by various procedures of photographic laboratory practice, photomechanical reproduction, and in a sense even by closed-circuit television programs.

In recent years many excellent examples of endoscopic still pictures in otolaryngology, bronchoesophagology, and proctology have been printed as 4-color illustrations in books and journals. Still color slides of these endoscopic subjects have become available for purchase for use in medical schools. Color motion pictures showing examining techniques, anatomy, physiology, and pathology are available for rental or purchase. Most of these films and slides were produced with Class-1 type equipment.

Still and motion picture illustrative materials have been used on public and closed-circuit television programs to demonstrate endoscopic subjects. Live direct telecasts, in black-and-white, of endoscopic subjects have been made on an experimental basis. Without the intermediate step of photography, however, lighting, optical alignment, and magnification became major problems. Nevertheless, when these problems are solved, direct live telecasts, especially in color, will be a great boon to the medical profession.

Endoscopes and Specula There appears to be much confusion between the terms "endoscope" and "speculum." The two terms are used interchangeably in many instances. For the purposes of this paper we shall define these terms according to their photographic uses. Their definitions in Saunder's current edition of the American Pocket Medical Dictionary appear to be the most acceptable, generally, and apparently follow the current usage and meaning of these words in the medical field. An endoscope is defined as an instrument by which the interior of hollow organs or body cavities may be examined by direct visual inspection such as the laryngoscope, bronchoscope, esophagoscope, peritoneoscope, proctoscope, and cystoscope. A speculum is defined as an instrument for opening or distending a body canal or cavity to permit visual inspection. But in photography it is desirable to divide endoscopes into open-tube and lens-system types, as outlined in the camera equipment classification to follow.

We consider all endoscopes to be relatively long in relation to their diameter and specula to be relatively short devices for examining small cavities. The length of the inserted portion of the speculum is not more than five times its diameter. This ratio of length to diameter of a speculum is an important

relationship to the ability of some types of equipment to light the field properly using coaxial illumination without depending upon the light reflection from the inside surface of the speculum. However, open-tube endoscopes *do* depend to a high degree upon internal reflections for illuminating the photographic field.

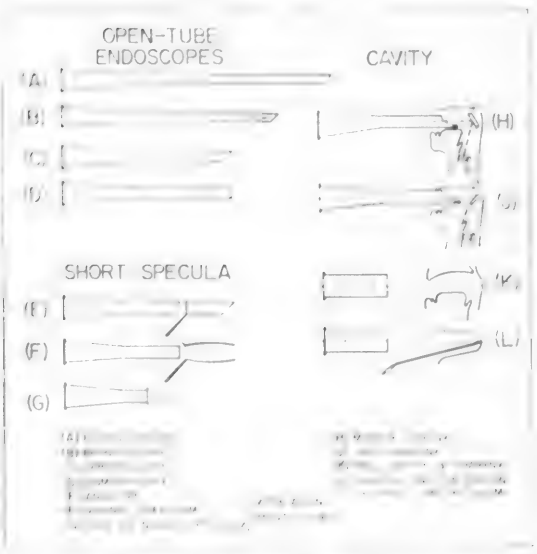

Figure 2. Typical Class-1 Endoscopes and Attachments

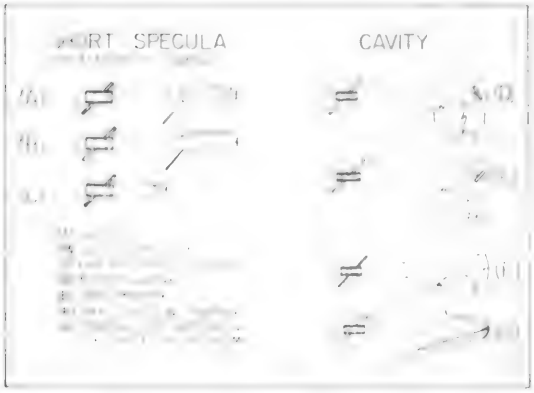

Figure 3. Typical Fields Photographed with Class-2 Equipment

Thus, in this paper the term speculum is used for tubes having a length to diameter ratio of not more than 5:1, and possessing no significant optical properties; and the term endoscope is used for tubes having a length to diameter ratio of more than 5:1, and whose optical characteristics are of definite importance.

Classification of Camera Equipment The basic design features of endoscopic cameras have led the authors to classify them into three groups, according to photographic and optical principles, instead of by specific endoscopes and specula or anatomical areas photographed (See Figures 2, 3 and 4). Each of the three classes includes both still and motion picture equipment.

Class-1 Equipment This class includes hand held cameras having a coaxial lighting system for open tube endoscopes, short specula, cavities, and small surgical fields. Obviously, such cameras can be used on a tripod when cavity or small field photography is done. The tubular attachments for specula and cavity work (attached to the camera) help align the field and reflect maximum light to it.

A glass slide and air seal are essential in Class-1 equipment to permit air pressure in certain endoscopes and attachments when used for lumen-finding, etc. The pre-warmed glass slide also protects the camera lens from condensed moisture coming through the endoscope or attachments. (Figure 5)

Class-2 Equipment This class includes tripod mounted cameras with coaxial lighting. They are intended primarily for specula not attached to camera, cavity, and small surgical field use. This equipment can be arranged for numerous field sizes, focusing distances, and magnifications, and is used for both still and normal speed motion pictures. High-speed motion picture work is pos-

sible with high-intensity light levels on the field

Class-3 Equipment Basically this class refers to a standard camera attached to a lens system type endoscope. Illumination can be provided by several means: a small tungsten lamp at the endoscope tip; by optical-rod-piped illumination from an external lamp; or by a separate light source inserted into the cavity to be photographed. In many applications it is difficult to obtain enough light with this equipment for motion pictures in color, or for the short still exposures necessary to stop motion. At the time of this writing, the most promising results with this class of equipment appear to be with units incorporating a quartz rod for the purpose of piping the external illumination to the distal end[1].

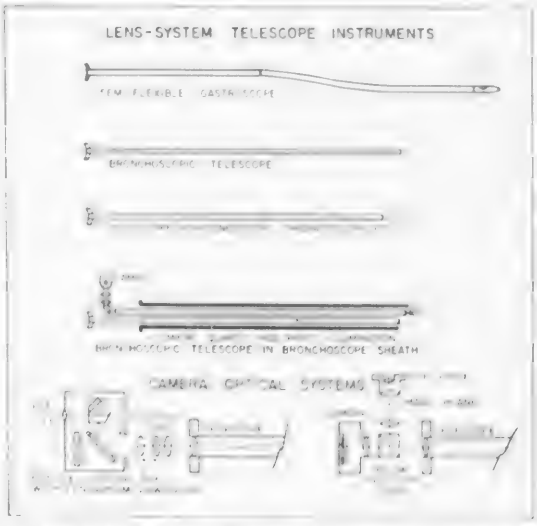

Figure 4. Typical Class-3 Equipment Systems.

Important Features of Class-1 Cameras The importance of Class-1 cameras is apparent when we examine their range of applications, grouped by the physical shapes of the endoscopic instruments used and the fields photographed. (See Figure 2)

These cameras are the dominant type in endoscopic photography because of their great versatility. In addition to open-tube endoscope use, they can also photograph any field in a speculum or cavity which can be examined by illumination from a physician's head-mirror; and the same photographic type open-tube endoscopes, attachments, and techniques can be used interchangeably with both still and motion picture cameras. This equipment can photograph the majority of endoscopic areas routinely examined by the physician or surgeon.

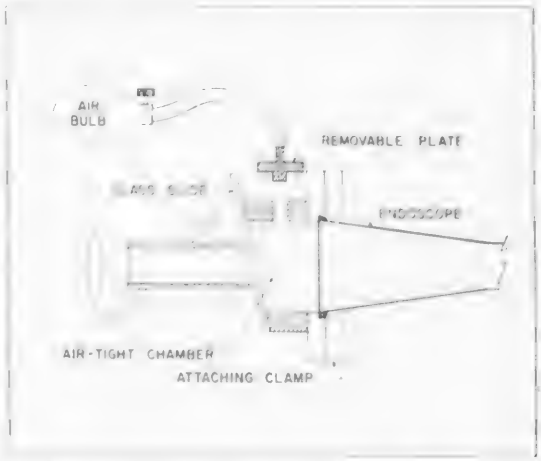

Figure 5. Class-1 Camera Air-Seal System.

Class-1 still and motion picture cameras combine the light source, camera, and on-the-lens-axis focusing viewfinder in one hand held unit. The camera is controlled by a trigger in the pistol grip handle. The endoscopes and attachment are connected to the camera by a quick acting attaching clamp which accurately aligns the endoscope with the camera lens axis. A heated glass-slide protects the camera optical part from gross soiling or condensed moisture, and provides an air-seal for lumen-finding and other special endoscopic techniques. This com-

illumination [illegible] greatly simplifies the problem of obtaining exact focus and correct exposure, insuring rapid use with sure results. The mechanical attachments which help align the camera eliminates the need for extra alignment or steadying equipment and permits rapid, accurate positioning of the camera.

The proximal coaxial illumination used with these cameras is important because of the relatively small change in light intensity at varying distances from the tip of an open-tube endoscope, compared to the distal illumination with small lamps or piped illumination at the endoscope tip in Class-3 equipment. This produces a more predictable exposure which is particularly important for color work.

The proximal lens system is of equal importance, rendering a truer perspective than the wide field distal lenses of Class-3 systems. Also, the use of larger, better corrected, and longer focal-length proximal lenses usually results in images of much better detail and contrast.

The endoscopes and attachments are brightly polished and nickel plated on the inside to reflect maximum light to the field. A short threaded section just inside the tip separates the true useful image of the field from the bright out-of-focus images reflected from the inner wall of the endoscope. These special photographic endoscopes have no built-in light carrier or other channel, since they would encroach upon the circular photographic field.

Sizes of photographic open-tube endoscopes vary, and generally are slightly larger than those used for routine examination. Minimum endoscope diameters are governed by their shape, length, and the camera lens system.

Since both the lens system and the lighting system are of major importance, extreme care must be used in endoscope design. Tapering of the endoscopes of small diameter is necessary to prevent vignetting of the image. Very small diameter specula may be used if they are properly tapered to avoid the vignetting problem.

Class-1 cameras cover only small fields, but this is an unavoidable characteristic of equipment designed primarily for use with open-tube endoscopes. Small fields always result from a choice of magnification high enough to show fine detail. Field sizes up to 2.5 in. by 3.5 in. (6.3cm by 8.9cm) for still cameras, and up to 1.5 in. by 2 in. (3.8 in. by 5cm) for motion picture cameras are about optimum.

Class-1 cameras have adequate free working distance from camera to field to permit their use during instrumentation when used for small cavity fields or with specula.

New Design Features The need for new camera improvements has arisen from the need for: (1) One type of camera to take adequate quality pictures for a wide range of applications; (2) To obtain optimum magnification on the film for each use; (3) To provide for more convenient and rapid use, with greater predictability of results.

The improvements in both still and motion picture Class-1 cameras are in four major directions: (1) Longer focal length lenses for larger images on the film; (2) Full frame rectangular film area when desired for cavity and small field use; (3) Full focusing range without loose supplementary lenses; (4) The use of an air-seal as standard equipment on both still and motion picture cameras to permit air pressure in the endoscopes and attachments for lumen-finding and special uses.

Motion Picture Camera Improvements

In 1953, the new BREMO-1 Model Bruhaker Holmgren 16mm motion picture camera (Figures 6 and 7) was designed and built, with all the above improvements, plus three additional features applying only to motion picture cameras.

(1) A new camera lens system was arranged to enable the use of longer esophagoscopes, 20 to 24 inches (50 to 60cm) total length, and to produce a larger image at the bronchoscope length of 16 inches (40cm). The camera lens system uses built-in positive and negative supplementary lenses, selected by levers. The normal lens focal-length of 3.5 inches (90 mm) becomes 4.5 inches (115mm) for the longer endoscopes by insertion of the negative supplementary lens. (Figure 7). The 90mm lens is moved by knob for focusing. A total of three magnification curves is provided for optimum magnification at each endoscope length or type of field photographed (Figure 8).

(2) This lens system required a different type of beam splitter, i.e., a glass plate with a partially transmitting aluminum coating, instead of the previous beam-splitting cube method with twin objective lenses for the camera and focusing telescope. About 85% of the light goes to the film, and about 4% to the telescope. The glass-plate beam splitter produces an image at the film plane free of aberration. The astigmatic error in the telescope, caused by the glass plate, is corrected by the astigmatic corrector plate, located just after the telescope erecting lenses (Figure 7).

(3) Endoscopic motion picture cameras should have a circular aperture mask just ahead of the camera film plane to mask off the bright internal reflections coming from the ground polished surface of the endoscopes. Such reflec-

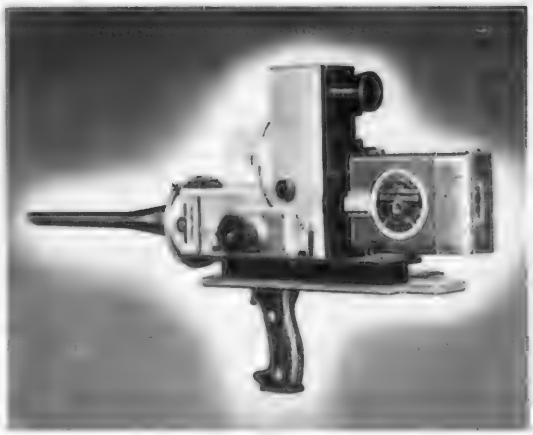

Figure 6. BREMO-1 Motion Picture Camera Shown with Laryngoscope Attached

Figure 7. Optical Diagram of BREMO-1 Camera

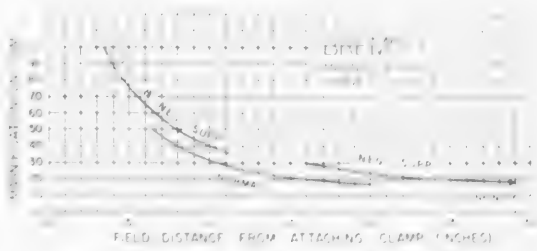

Figure 8. BREMO-1 Magnification Curves.

tions distract the eye of the observer away from the central picture area. (The previous model camera had a masking device at the camera, but none in the telescope, so the masking action could not be seen while operating the camera.) The new camera has twin masks in the telescope and camera, with nine stations, so that the size of the mask hole can be selected visually by knob, to fit the requirements of each endoscope, attachment or cavity field, for best composition. One mask station is for the full rectangular 16mm film frame for small field and cavity work (Figure 7).

An aspheric condenser lens is used in the illuminating system to increase the light reaching the field. This compensates for beam-splitter mirror reflection losses, and permits full frame operation instead of circular field operation only. The previous camera utilized a wider angle shutter-opening, which was made possible by limiting the film area to a circular field 0.25 inch in diameter. The light reaching the field is about 7,500 foot-candles, incident light (nearly equivalent to direct summer sunlight), permitting color photography at apertures of f/11 to f/16 for most use with color films of Exposure Index 16 at 16 to 24 frames per second.

The ear speculum holder, especially designed for this camera, has interchangeable tubes between holder and speculum to provide a choice of several magnifications. The speculum holder contains a 3mm thick piece of heat absorbing glass in addition to the regular heat absorbing glass in the camera condenser system (Figure 7). There is a CC-20 R color filter mounted with this second heat absorbing glass to correct the red deficiency resulting from it. There is a hole through the center of each piece of glass to provide a clear path for the light rays to the camera lens.

The magnifications on the film (Figure 8) are multiplied by 5 to obtain the final effective magnification seen on the motion picture screen by the audience, assuming the use of a 2-inch projection lens, and the audience seated near the projector.

Still Camera Improvements Additional study was needed to make the changes required in still cameras. This led to the new BRESCO I Model Brubaker-Holinger still camera. The larger film image sizes adopted brought the magnifications very close to the 1-1 image size. Since at these magnifications the camera cannot be properly focused by moving a single anastigmat lens (Figure 9, top) new methods were developed. (Our original bronchoscopic still camera was built in 1946)[3].

The intermediate step in the design of the latest still camera was the use of two fully corrected positive lenses, moving one of them to change the spacing (and thus the camera lens focal length) for focusing (Figure 9, center).

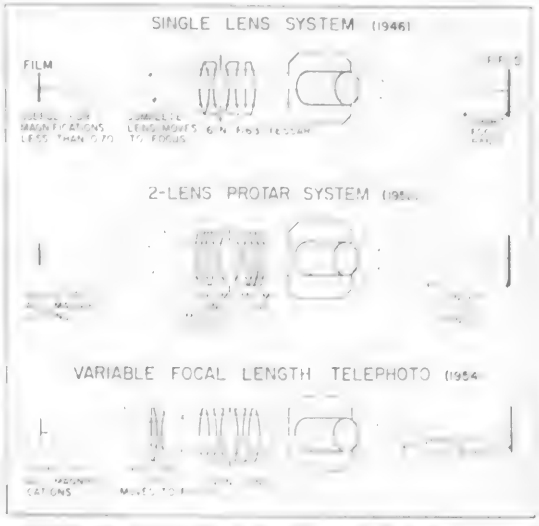

Figure 9. Focusing Methods. Class-1 Still Cameras.

This led to the present BRESO-1 design with a telephoto type system, in which the negative part of the lens system is moved for focusing (Figure 9, bottom).

The variable focal length telephoto system gives the total focusing range needed without using any supplementary lenses (Figure 10). This system ranges from [illegible] to 8 inches focal length while changing the focus from 7 to 26 inches from the attaching clamp (Figure 12). The magnification curve has a flatter slope than either of the previous cameras, producing less change in magnification per inch of change in focusing distance. In this respect it is the best of all presently known methods. The camera provides optimum magnification for each endoscope length and type of field photographed; a large enough image to prevent film grain from obscuring fine detail, yet small enough to obtain good depth of field.

The legend of Figure 13 explains many of the internal parts of the BRESO-1 camera. To reduce the physical length of the camera and to avoid interference with the operator's right shoulder, the camera optical system was folded into a U-shape. A porro erecting system, consisting of four first-surface mirrors (two at the base of the U and two in the Visoflex box and 90-degree eyepiece) produces an erect and laterally correct image in the eyepiece for safe manipulation of the endoscopes under constant visual supervision of the field.

The photographic light source is a No. 22 flash lamp. This produces a high intensity illumination on the field about equal to four times direct summer sunlight, which is needed for adequate depth of field at 1/50th second exposure time. The flash lamps are carried in removable Bakelite caps which have bayonet electrical contacts, permitting

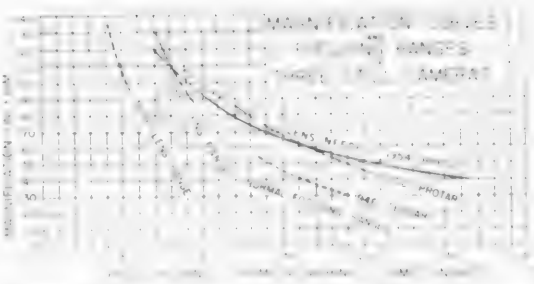

Figure 10. Magnification Curves and Focusing Ranges of Three Still Cameras

Figure 11. BRESO-1 Still Camera shown with Ear Speculum Attached

Figure 12. BRESO-1 Magnification Curve

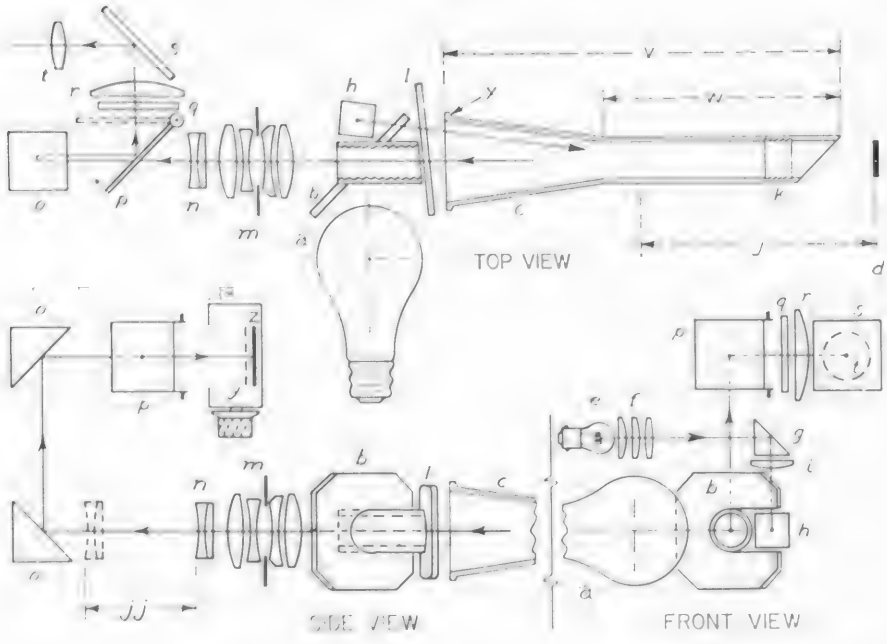

Figure 13. BRESO-1 Optical Diagram. (a) Flashlamp, GE No. 22. (b) 45 degree plane mirror to reflect photographic light into endoscope. Tube threaded on inside shields camera lens from direct flashlamp light. (c) Open-tube endoscope such as: Esophagoscope, Bronchoscope, Laryngoscope, Sigmoidoscope, or Speculum Attachment. (d) Field plane of sharp focus. (e) Tungsten focusing lamp, GE No. 1493, 6.5 volt, 2.75 amp. (f) Condenser lenses. (g) Prism. (h) First-surface 45 degree mirror. (i) Lens to project image of condenser lens to field for focusing light. (j) Range of focus adjustment of camera, 7 to 26 inches from flange "x". (jj) Focusing motion of negative lens "n", controlled by knob. (k) Threads at endoscope tip to produce light ring around image on film. (l) Optically flat glass slide; protects optical camera parts from moisture condensation or gross soiling; protects field from glass particles from flashlamp. (m) Anastigmat lens, E.K. Enlarging Ektar, 4 inch, f/4.5. (n) Specially corrected negative lens, 6 inch focal length. Lenses "m" and "n" form a telephoto type variable focal length lens system, varying from 5 to 8 inches focal length. Lenses are coated for maximum transmission of light. (o) Precision first-surface mirrors; U-shaped light path reduces camera length. (p) 45 degree mirror in Leica Visoflex box (moves out of way for photography). (q) Special high transmission groundglass focusing screen in Visoflex box. (r) Field lens of the 5X, 90 degree magnifier on Visoflex box. (s) Plane mirror in 90 degree magnifier. (t) Eyepiece lens in 90 degree magnifier. The 4 mirrors "o,o,p,s" form a porrorecting system, giving an erect and laterally correct image in the eyepiece. (u) Leica box I-F with synchronized flash contacts. (v) Total endoscope length. (w) Free working length of endoscope (4.2 inches less than total length). (x) Endoscope flange held in attaching clamp. (y) Focal plane shutter in Leica box, synchronized with No. 22 flashlamp. (z) Color film in camera (preferably 35mm Kodachrome F for fine-grain image).

rapid interchange of lamps. Electronic flash is not used because of: (1) the difficulty in maintaining absolutely safe insulation of the camera and metal endoscopes from the higher voltages required; (2) the added cost and weight of an electronic power supply large enough to equal the light from a No 22 flash lamp; (3) the reciprocity law failure of color film at short exposure times.

To see the field for locating and focusing, a tungsten focusing lamp projects a beam of light into the endoscope or attachment and onto the field. The illumination is bright enough for focusing at the taking f/stop, which is about f/16 to f/32 for most fields when corrected for magnification.

Summary

This paper covers new work done by the authors during the past five years, especially since 1953. Certain terms in endoscopic photography are defined and camera equipment is classified according to photographic and optical principles. The advantages of proximal coaxial illumination are shown. The need for higher magnifications and the greater range of applications which led to new camera designs are discussed. A new motion picture camera and a new still camera are described. Examples of published endoscopic color pictures and 16mm color films made with the new cameras are listed in the references.

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The Decolorization of Bouin and Zenker Fixed Gross Specimens for Photography*

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Introduction

IN any pathology laboratory it may happen by mistake that a gross surgical or autopsy specimen is put into Bouin's or Zenker's fixative before it has been photographed. These solutions impart a uniform color throughout the specimen, Bouin's a yellow, and Zenker's a yellowish orange. Esthetic considerations aside, the uniformity of hue largely obliterates the otherwise visible detail and many of the gross structural features of the specimen, giving it in most cases the appearance of an amorphous mass, which often it is not. Thus, restoration as close by as possible to its original appearance is desirable for a good photograph.

The techniques described in this paper will not bring about perfect restoration. They often come close, however, and in every case will improve the appearance to the extent that at the very least, a good black-and-white photograph can be made. It is important that neither the microscopic structure nor the ability to take stains be altered by any special treatment given the specimens, else their diagnostic value will be diminished or destroyed. (See Figure 1)

Both Bouin's and Zenker's fluids are excellent fixatives, penetrate the tissue rapidly, preserve the tissue elements, and harden them so that subsequent preparatory steps will not alter their structure. It is mainly this last quality that enables a seemingly damaging treatment to be successful and apparently harmless. Tissues treated as described in the following and subsequently processed by conventional methods for microscopy are indistinguishable in microscopic appearance from similar tissue not subjected to the decolorizing process.

Experimental Method

Because gastric mucosa is among the most delicate of tissues, segments of human stomach wall from fresh surgical specimens were used in the development of the techniques to be described. Sections from the same specimens prepared by usual histologic methods were used for comparison with those which had been decolorized while in the gross state. Both hematoxylin and eosin and trichrome stains were used with equally good results. Tissues other than stomach were also treated with excellent results.

Technique

Bouin's fluid contains picric acid, formalin, and acetic acid. It is the picric acid that gives the yellow color to the tissue. This color is removed from *embedded, sectioned and unstained tissue*

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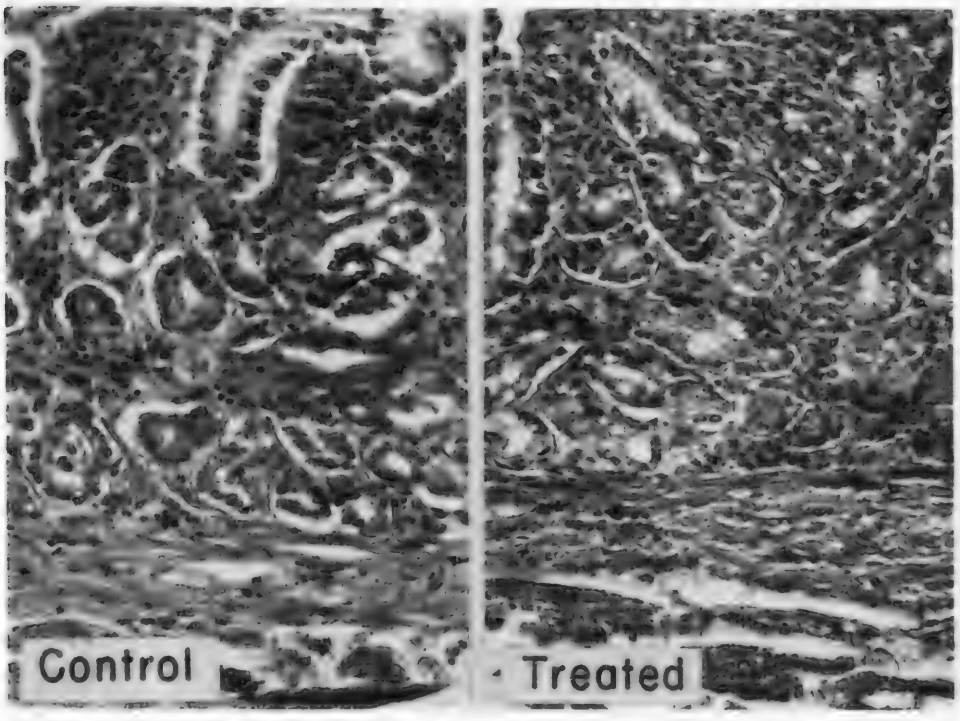

Figure 1. Photomicrographs of sections of stomach wall from the same specimen to show that there is no change in microscopic appearance after decolorizing the gross specimen.

by momentary immersion in a weak solution of ammonia.

Gross specimens, too, may be decolorized by immersion in dilute aqueous ammonia. A 1% solution of strong (28%) ammonia in water was found to be satisfactory. This value is by no means critical; experiments indicate that equally good results are attained with concentrations within a range of 0.25% to 5%. If laboratory ammonia is not available, household ammonia (either clear or cloudy) may be used with a dilution of 1:20 with water. The ammonia solution should be made up in generous quantity, since frequent changes of solution are necessary.

The procedure for removing the yellow color from Bouin fixed specimens is as follows:

1. Wash the specimen in running water for at least four hours.
2. Immerse the specimen in a generous quantity of ammonia.
3. Change the solution three or four times at five minute intervals and thereafter whenever it reaches a color saturation comparable to a K-2 filter. The specimen should be rinsed in water between changes. After the initial changes it will take increasingly longer times to attain the color saturation mentioned. As color leaches out of the specimen, the interval between changes increases.
4. When the specimen appears to be free of color, regardless of continued yellowing of the ammonia solution, it should be briefly washed and placed in one or two changes of 70% to

80% ethyl alcohol. Color will continue to leach out of the specimen in the alcohol, although at a reduced rate. Depending on the size and nature of the specimen, much of the natural color is restored in this solution.

The specimen at this time is ready for photography. After photographs have been made, the specimen should be returned to the original fixative for subsequent processing to histological sections.

The total length of time required for carrying this process through varies somewhat, since some tissues retain the color longer than others, but at least twenty-four hours should be allowed for adequate decolorization.

Zenker's fluid contains potassium bichromate, sodium sulfate, and mercuric chloride. It is the potassium bichromate that colors the tissue. This color is removed from *histological sections* by treating with Lugol's iodine solution, followed by sodium thiosulfate. Similar treatment for gross specimens is not satisfactory. Since potassium bichromate is very difficult to remove from tissue, rather strong chemical treatment is necessary. Two methods were devised, the first is as follows:

1. The specimen is first washed in running water for an absolute minimum of twelve hours; twenty-four hours is recommended.
2. It is then submerged in a 0.1% solution of potassium permanganate. It remains in this solution until a maximal deep brown coloration has been reached.
3. This dark brown color, due to manganese dioxide deposited in the tissue, is removed with a 5% solution of either potassium metabisulfite or potassium bisulfite. The specimen when removed from this solution is slate gray in color.
4. The gray color is eliminated by use of a solution of 0.1% hydrochloric acid or a 5% solution of sodium chloride.
5. The specimen is then put directly, without rinsing, into 70% to 80% alcohol for restoration of its natural color. Generally this is not as satisfactory as that attained after decolorization of Bouin fixed pieces.

An alternate method for the removal of color from a Zenker fixed specimen consists of the following, assuming it has undergone the initial washing:

1. Immersion in a 25% solution of strong hydrogen peroxide until a deep slate color is reached.
2. After rinsing, the specimen is treated in hydrochloric acid or salt solution as in the first method, followed by the alcohol.

Except for the initial washing, the removal of color from Zenker fixed material can be accomplished in an hour or less. After photography the specimen is returned to fixative for further processing.

Summary

The color and amorphous appearance imparted to gross surgical and autopsy specimens by the commonly used Bouin and Zenker fixatives can be removed without histologic alteration by treatment with weak ammonia solution for Bouin's, and strong reducing agents for Zenker's. Their appearance, while seldom as it was before fixation, is greatly improved, and for black-and-white photography is at least as good as the fresh specimen.

An Award Selection

26th Annual Meeting of the
Biological Photographic Association
Rochester, New York • 1956

"Fetus in Amniotic Sac"

MARJORIE E. JACOBSON, Buffalo, N. Y.

Certificate of Merit

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Photography of Bacterial Culture Tubes and Plates*

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PHOTOGRAPHY of culture tubes and plates in black-and-white and color has presented a difficult challenge to many scientific photographers. The author has developed a method which has proved successful using standard photographic equipment.

Figure 1. Setup for photographing culture tubes.

Assuming the specimens have been properly prepared by the laboratory, the photographer has only to examine the glass surfaces to be sure they are free of finger marks, wax pencil smears, etc. These are usually removed with an application of carbon tetrachloride or a similar solvent. Condensation within a tube may occasionally occur and can be eliminated by a brief warming.

Culture Tubes A laboratory ring stand with a test tube clamp affords a simple means for holding the tubes. Careful tightening of the clamp is important because too much pressure will shatter the tube and too little might allow it to drop and break. In either case the culture is destroyed and the individual exposed to serious infection. Two 3200K, 750 watt, photographic spotlights with focusing means are placed on each side of the tube at angles of between 45° and 55° so their beams intersect on the subject (See Figure 1). Using this type of lighting, reflections on the surface of the tube facing toward the camera are eliminated and excellent detail can be observed. In most instances a dark background should be used to bring out the salient features of the culture. After the camera is properly aligned in the horizontal position and focused, rotation

* Presented at the 26th Annual Meeting, Rochester, N.Y., 1956.

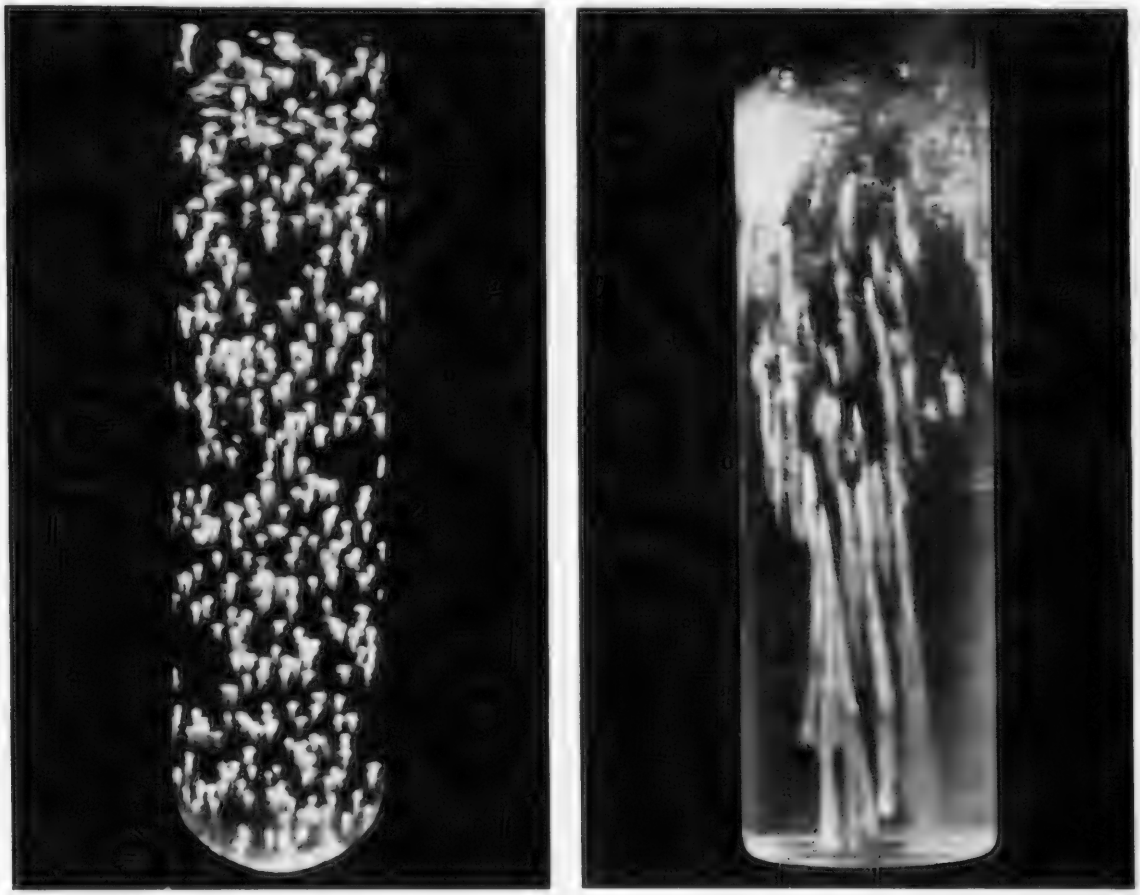

Figure 2. Typical photographs of culture tubes using method described. Innoculations of human sputum showing growth of (A) Streptococci, (B) Staphylococci

of the tube might be necessary to effect the best presentation of the specimen. A reflected light reading is made with the meter held directly in front of the tube and the exposure time computed.

Culture Plates. The plates are set on a glass shelf over a diffuse light source and a circular opening of the same diameter as the plates is cut in a piece of black paper to mask out surrounding light. A 3200K, 500 watt lamp under the diffusing material, transilluminates the cultures. A continuously adjustable [illegible], with a Variac, is convenient for varying the intensity of the light source for different effects. Two 3200K spotlights are used for incident lighting, making it possible to employ [illegible]

(See Figure 3). The camera is inverted over the plate and a light meter reading is taken with the meter directly above the culture for exposure determination. Kodak Portrait Pan and Ektachrome Type B films are used by the author to photograph both tubes and plates.

Summary Simple methods for the photography of bacterial culture tubes and plates are described; emphasis is placed on lighting, subject placement and camera angle to secure successful results in black and-white or color.

(A) Right

(B) Lower Right

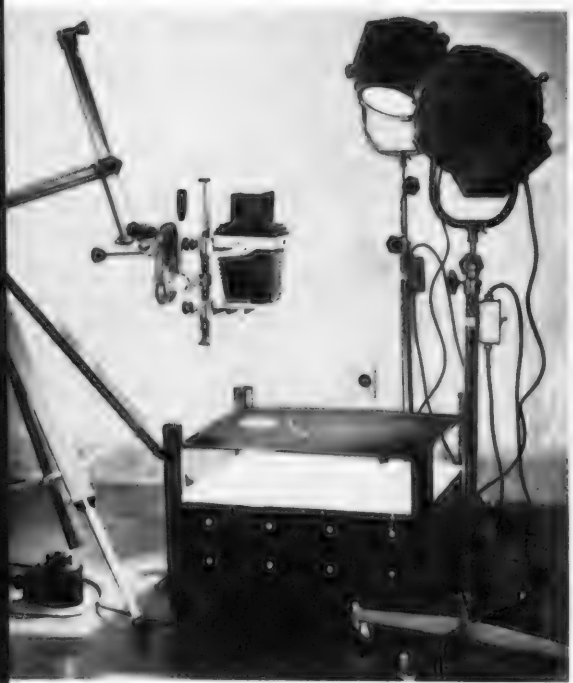

Figure 3. Setup for photographing culture plates.

Figure 4. Culture plate photographs by method described. (A) Alpha-Hemolytic Staphylococci (B) Drug sensitivity.

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Simple Condensers for Ribbon-Filament and Mercury Vapor Microscope Lamps*

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Introduction

INCREASED use of phase contrast microscopy in biology has brought a need for more intense sources of illumination, especially for photomicrography by this method. Many of the standard light sources used in ordinary bright-field microscopy are inadequate for phase contrast because of the great reduction in light by the phase rings. Simple methods are here described for utilizing the light produced by lamps which give an elongated image of the incandescent source such as the ribbon-filament and mercury vapor lamps.

The ribbon-filament lamp which is so satisfactory for ordinary microscopy because of its suitability for critical illumination is provided with an optical system for producing an enlarged image of the filament. A convenient and satisfactory method for using it for bright field work is to arrange the lamp at such a distance from the mirror of the microscope that the width of the filament image is approximately equal to the diameter of the mirror. The amount of light thus obtained is sufficient for the lower magnifications of phase contrast also. However, the amount of light obtained by this arrangement is usually insufficient for observation or photomicrography by oil immersion phase contrast. The filament in a ribbon-filament lamp has a ratio of width to length of about 1:6. Thus when used at a distance sufficient to cover the mirror of the microscope the image of the filament will be six or more inches long and much of the available light will be wasted.

Cylindrical Bottle Method

The simplest method for concentrating the light from such a source (as well as from the mercury vapor lamp) is to interpose a cylindrical bottle of about four or five inches diameter, filled with water in the beam of the light. This will shorten the image but will not change its width, thus permitting all of the light from the filament to be concentrated on the mirror. In Figure 1 the dotted lines indicate the size of the image of the filament obtained by this method as contrasted with the long image obtained when the condensing bottle is not used. More effective heat-absorbing fluid

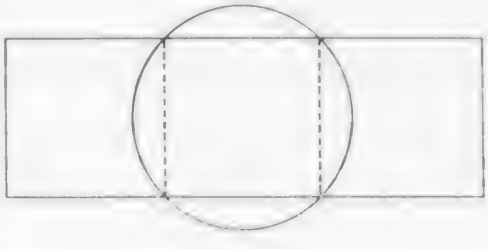

Figure 1

* The opinions and statements contained herein are the private ones of the writers and are not to be construed as official or reflecting the views of the Navy Department or the naval service at large.

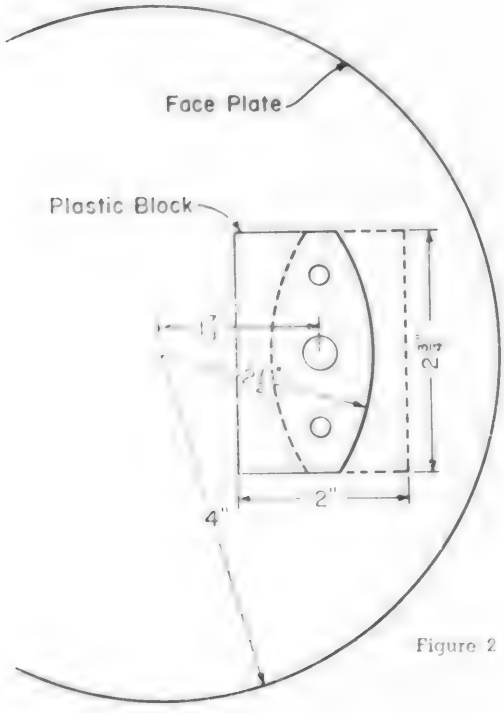

Figure 2

Figure 3

may be used instead of water, or colored solutions may be used as filters.

New Methods

Although this is the simplest method for concentrating the light from the types of lamp under discussion it has the disadvantages of (1) bulkiness, (2) being difficult to adjust to an inclined position, and (3) fragility. We have lately used plastic condensers in the form of double convex lens strips. They overcome all of the disadvantages of the cylindrical bottle and also have excellent heat-absorbing properties. Two methods for producing such condensers have been successfully used. Sheet *Lucite*, 2 inches thick, is used in both methods. In the first method, a cylinder of *Lucite* 3 inches in diameter and 2 inches long is turned from the sheet *Lucite* on a metal lathe. Sectors about 3 or 3½ inches long are then cut at right angles to the ends of the cylinder. These make plano-convex lens strips. Two of these are then fastened together by the plane surfaces produced by the cut just described. We have found it best to fasten them together by means of "Selectron", rather than using a cement dissolved in a solvent. Selectron is methyl methacrylate to which t-butyl hydroperoxide is added as a polymerizing agent. After the plastic has been allowed to set for 48 hours the curved surfaces, if they have marks on them from the turning tool, are then polished on a buffing wheel using buffing compounds of increasing fineness.

The second method involves making a solid piece of plastic in the form of the one just described. A piece of clear plastic [illegible] is mounted by its 2 in. x 2¾ in. dimension on a face plate of a lathe. The piece of plastic should have the end of the 2¾ inch dimension milled parallel. Then two ¼ inch, 20-threaded holes and one ⅜ inch reamed hole, all holes ⅜ inch deep, are located on the center line of the 2¾ inch dimension (see Fig. 2). The purpose of the ⅜ inch reamed hole is to mount the plastic block a definite distance from the center of the lathe spindle, the face plate having a stud mounted to it, upon which the plastic block can be revolved 180°. The distance of the stud, offset from the center of the lathe spindle, determines the thickness of the finished condenser.

In this way, when one radius of the condenser has been turned, the screws can be removed from the tapped holes, the block turned 180°, the screws replaced and the other side of the condenser turned (see dotted lines, Fig. 3), giving a uniform radius to both sides of the condenser. The necessary polishing should be done as in the first method.

Either of the plastic condensers here described can be placed in a metal mount (Fig. 3), the latter being fastened to the table between the microscope and the lamp source at the proper distance for bringing all of the light upon the mirror. It is also possible to place it upon an optical bench or attach it to the front of the lamp itself. The longitudinal axis of the condenser, (i.e., the axis parallel to the curved surfaces) should be arranged at right angles to the plane of the fan-shaped beam of light.

Summary

Simple methods are described for preparing condensers which concentrate the light from ribbon filament and [illegible] vapor lamps. These condensers are particularly useful for phase contrast microscopy.

Acknowledgements

The authors are indebted to Dr. Esther Hardenbergh for assistance in work with the Selectron and to Mr. Edward Frazier for the layout and machining of the plastic condensers.

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Adapting Motion Picture Editing-Equipment for Frame Counting in Time Lapse Cinematography*

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Introduction

IT is well known that the analysis of time lapse motion picture films is facilitated by use of a frame counting device. The commercially available equipment is often too costly for small laboratories, and the majority do not provide for image viewing and frame counting simultaneously.

In our study of the effects of chemicals on the mitotic cycle, using phase optics microcinematography, simultaneous viewing and counting has obvious advantages. Only by close analysis of each frame is it possible to follow the various stages of cell division from the beginning to the end when different chemical treatments are applied.

Equipment Adaptation

A *Bass* 16mm Standard Motion Picture Editor was modified, cheaply and effectively, by the addition of a *Veeder-Root* magnetic reset counter (Figure 1) actuated by a microswitch riding on a square cam mounted directly on the prism shutter shaft (Figures 2 and 3). This cam is mounted so that the microswitch is released once per revolution of the prism, opening the switch when the flat face of both the prism shutter and the cam are oriented at right angles to each other but center essentially on the same horizontal plane. The viewer lamp and the counter are controlled by the same switch, as shown in Figure 3.

The list of materials necessary for this adaptation follows:

(Purchasable Items)

1 Veeder-Root magnetic reset counter (B120506) in standard mount.

1 Microswitch (CMS-BZ-2R-2)

(Made-to-order Items)

1 counter mounting flange (not necessary if a side window counter is purchased.)

1 microswitch mounting plate to provide clearance for the threading lever (Figure 2)

1 die cam, the corners of which have been machined to provide contact surface (Size will depend on make of editor)

In actual use, the counter has been found to be accurate, conforming with the frame count recorded by the mechanical time lapse drive used. However, there are two disadvantages as far as fast editing is concerned. The added mechanical components place a slightly greater drag on the film than does normal braking. Nevertheless, the film can be wound at high speeds without damage to the sprocket holes. The other fault arises from the failure of the microswitch spring to follow the die cam accurately. At high speed the spring develops a flutter keeping the microswitch open most of the time, thus missing erroneous counts. The situation can be corrected by placing tension on the microswitch spring and adjusting the tension of the spring. Then both the microswitch and the counter can be operated at speeds close to their rated capacities.

The author makes grateful acknowledgement to the Department of Physics Shop Staff for the construction of parts and final assembly of the counter described.

* Aided by research grant C-2178 (C2) M&G from the National Cancer Institute, Public Health Service administered by E. J. Dunford.

Figure 1. Viewer with counter mounted on top

Figure 2. Rear view showing mounting of components. For detail see Figure 3.

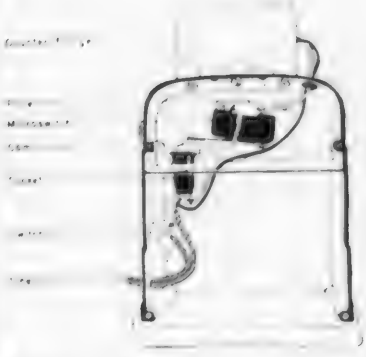

Figure 3. Detail view of installation and wiring.

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A Simplified Method of Photomacrography

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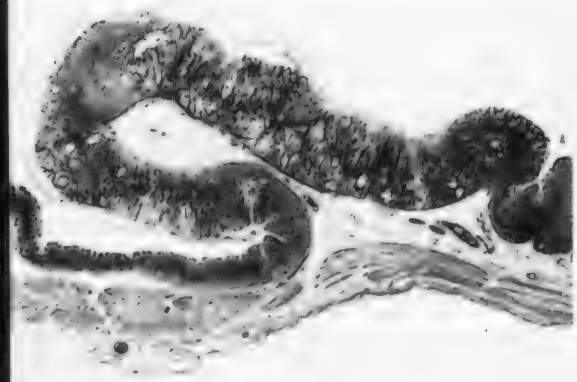
OCCASIONALLY medical photographers are called upon for photomacrographs or to reproduce the whole portion of the microscopic slide. In small photography departments, construction of a permanent photomacrographic unit is unfeasible because of the space required for this seldom-requested photographic procedure.

I have found that by using a condenser-type enlarger, photomacrographs can be made as easily as enlargements. I simply place the thoroughly cleaned slide in a 35mm negative carrier, coverglass side toward the lens, and place this in the regular film carrier position just below the condensers. In other words, I merely substitute the microscopic slide for a negative.

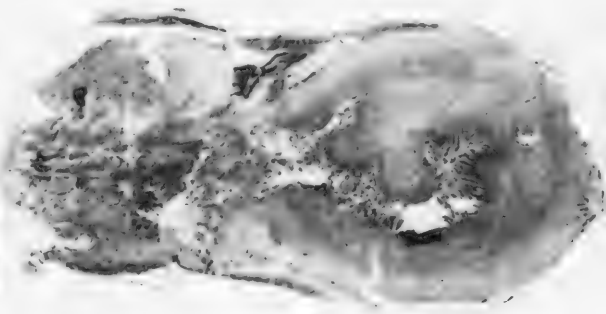
The slide is then projected on paper for a negative print or on film for a negative. Color negative and positive materials as well as Polaroid materials may be used.

I have used everything from 58mm to 7½ inch camera lenses and projection lenses to obtain the proper field size and magnification. Regardless of the lens used, the results have shown sharp, clear negatives. The accompanying illustrations are examples.

Chicken embryo (6 ×). Negative print.



Hypertrophied gastritis (10 ×).



Mucus forming adenocarcinoma (10

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Slit Lamp Photography of the Eye*

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THE slit lamp is used by the ophthalmologist to examine the anterior portion of the eye. This examination is also referred to as biomicroscopy since it provides a microscopic view of the cornea, anterior chamber, lens, and the anterior third of the vitreous.

The apparatus used in this technique consists of two main portions: the light source which provides illumination in the form of a [illegible] and the microscope. The slit image beam is directed obliquely on the part of the eye to be examined. Observations are made by means of a low power binocular microscope focused on the illuminated area.

The slit lamp was first designed in 1911 by Alvan Gullstrand in Heidelberg, Germany. Since then it has undergone many changes and extended in its application. In 1918 Vogt introduced accurate focusing of a narrow beam. This invention made possible an "optic section" of the media mentioned above. For many years the only method of recording observations made with the slit lamp was by [illegible]. In spite of all of the many advances in the subject this basic limitation could be [illegible].

However, photography as applied to [illegible] provided a [illegible] means of recording [illegible] for [illegible]. Moreover it also provided [illegible] material.

The main problem in adapting photography for recording slit lamp images has been to obtain adequate illumination. The problem has been similar to that encountered in [illegible] where the [illegible] light source [illegible] various types of illuminants and film have been used by the authors. Our most successful results have been obtained with the following sources which we have designated as Type I and Type II:

Type I Electronic flash of 1/3000 second duration, 400 watt seconds output and an equivalent color temperature 6500K.

Type II [illegible] of 1/50 second shutter speed. This provides an equivalent color temperature of approximately 3800K.

The [illegible] and the [illegible] of the Haag-Streit illuminating [illegible] were modified to accommodate [illegible] and the focusing light.

For the Type I [illegible] Ektachrome E2 Daylight film (Exposure Index 32) and for the Type II source, Ektachrome F film.

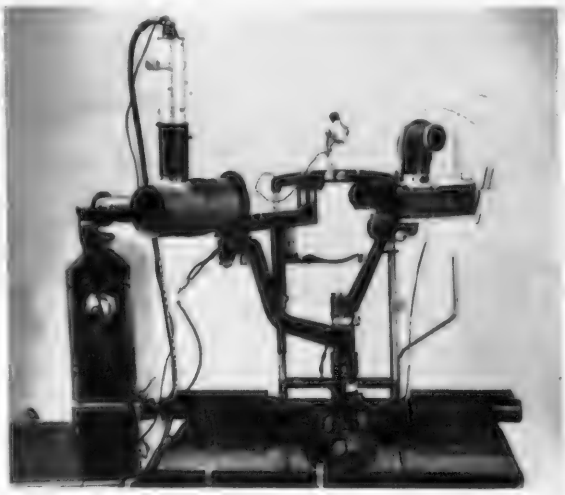

Figure 1. A general view of the modified Haag-Streit slit lamp. This particular arrangement is for [illegible].

* Presented at the [illegible] Meeting [illegible]
** Department of Medical Photography.

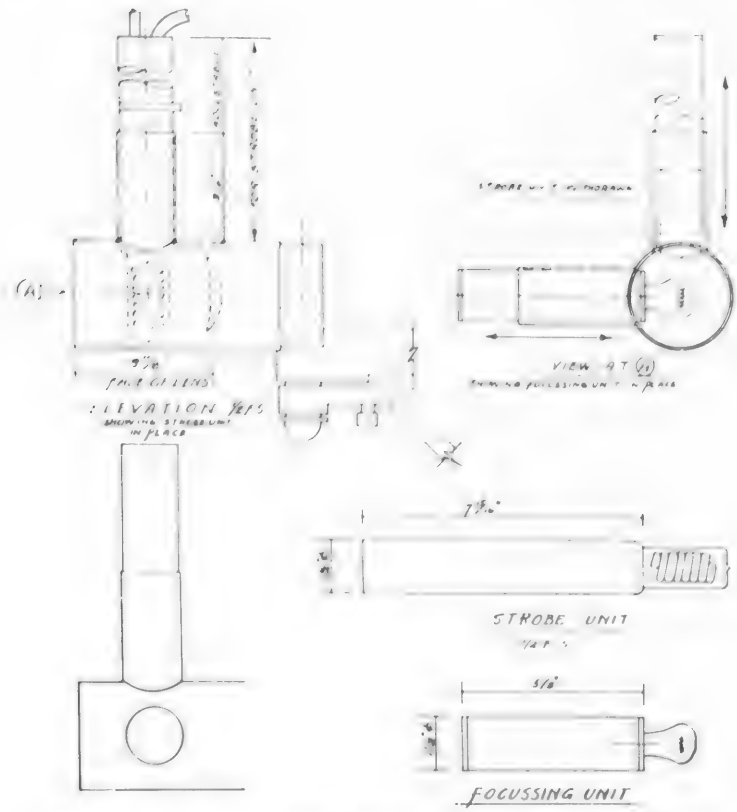

Figure 2. A schematic of the modified illuminating arm for use with electronic flash.

Two different apparatus arrangements were used for the photography. The first for magnifications up to 6×. (See Figure 1). The second (Figure 1) for [illegible] up to 30×. The first utilizes a system of extension tubes mounting a Leitz Milar 6 [illegible] and a Leica III-F camera body. The second consists of the standard binocular biomicroscope, to one barrel of which is attached a Leitz "Mikas" photomicrographic unit and the Leica III-F camera body.

The technique of taking useful pictures requires a considerable degree of skill in the use of the standard biomicroscope, as well as [illegible] photographs. The patient selected for photography is seated comfortably at the slit lamp in the usual fashion. Then a preliminary examination is made with illumination provided by the focusing lamp. When the appropriate field is found, the patient is cautioned to keep still while the focusing lamp is withdrawn from its tube and the flash unit is dropped into place. It is important to have the patients' cooperation during this two-seconds time lapse, because changes in the field cannot be observed.

The problem of synchronization (Figure 3) involves three elements:

1. Releasing of the camera shutter, synchronously with
2. the firing of the flash unit, and
3. the [illegible] general illumination, triggered by the electronic flash via a photo[illegible]

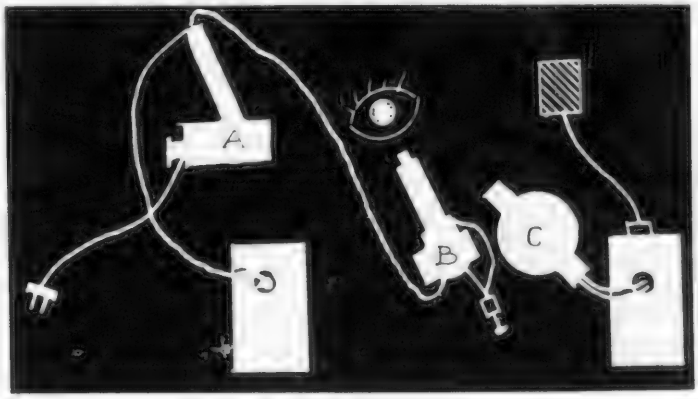

Figure 3. Shows the synchronization used with a two light system. (A) Electronic flash synchronized to the power pack and to shutter of camera (B). (C) is a slave unit for over-all illumination, connected to the power pack synchronized with (A) and (B) by means of a photocell.

Suggested exposures for Ektachrome E, Daylight film, normally processed, and for magnifications up to 6×, are given below.

Subject Field	*Lens f/number*
Eyelids	11 to 8
Sclera	11 to 16
Anterior chamber	5.6 to 11
Lens (under mydriasis)	
Of the anterior lamellae	4 to 5

The f/number depends upon the width and direction of the slit lamp beam and, when involved, upon the color of the iris.

To photograph the angle of the anterior [illegible] we employed a special reflector [illegible] a gonioscope. In photographing the fundus a Hruby lens was used.

For higher magnifications, up to 30×, we found it necessary to use high-speed black and-white films (E.I.300-400) with wide open lens. But promising results have been obtained using Ektrachrome film processed to [illegible]

REFERENCE

Roger, H., Kodachrome Photomacrography of the Eye [illegible]

Prince, H., A new slit lamp color camera, A.M.A. [illegible]

Inexpensive Modification of Darkroom Timer for Time-Lapse Intervalometer*

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TWO *Lektra Timers, Model TM-8*, were modified to recycle, providing a pulse that could actuate single frame advances on a motion picture camera and also provide a variable time interval between exposures.

The original camera and microscope design incorporated a Xenon flashtube light source synchronized with the camera for exposure and an adjustable voltage tungsten source (coaxially mounted with the flashtube) to provide light for monitoring and to aid in making adjustment.

After initial tests, several variations were explored, including solenoid-operated shutter devices that functioned simultaneously with special film drive mechanisms on the camera to provide longer exposure.

Ribbon filament, or arc, lamp sources are useful where the light from a speed-light is insufficient for adequate film exposure.

Figure 1 shows how the two timers were combined. The cable from the lower corner of timer A is used to control the camera solenoid or other film drive mechanism, and a cable connecting the two timers is incorporated to provide recycling independent of any other circuit.

Figure 2 illustrates the basic modifications necessary on each of the timers. The added relays are encircled. The relay in timer A, a DPDT type, is wired through a switch to the outlet labeled "printer". The relay in timer B, an SPDT type, is connected in the same way as the one in timer A. The switches are located adjacent to the main power switches (c.f., Figure 1).

In operation, when the relay in timer A is energized, one set of contacts close and a separate pulse is transmitted through the cable to the camera solenoid or other camera controlling devices. This separate circuit makes possible the use of direct current to operate control devices. When this first time-interval is complete, the other set of contacts on the relay make and cause, via the connecting cable (c.f., Figure 1), timer B to start a time interval by remote control. The contacts of the relay in timer B are connected through the connecting cable to the "remote control" circuit of timer A. When the time interval of timer B is complete, the contacts of the relay close, causing timer A to start another time interval. Recycling continues in this pattern, and the intervals of time on either timer may be changed at will during operation to meet particular requirements.

The added relays could be incorporated as replacements of the original relays by using types that have 3 or 4 double-throw poles. However, by using separate relays in connection with switches, the operator has (or toggles) of recycling is possible without turning off the timers completely. Also, the original circuits are not affected in any way when separate relays are used.

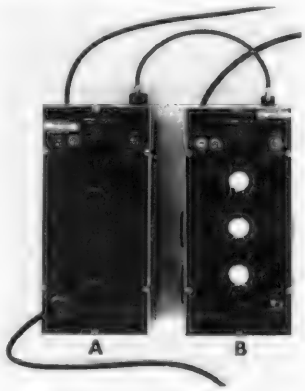

Figure 1. Modified Lektra Timers.

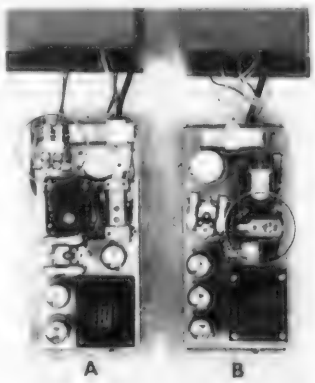

Figure 2. Added relays encircled. See text.

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Inexpensive Wood Processing Tanks for Color Film*

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IT is advantageous for the biological photographer to process his own color films, rather than send them to a commercial processing concern. Some of the obvious advantages are as follows: 1) to see results as soon as possbile for checking exposure, etc., 2) to facilitate experimentation with different exposures and processing conditions, 3) to be in a position to handle rush work, 4) to lessen operating costs.

It is of interest to note that the speed of most color films can be changed with only a small change in color. Often the change is so light that it is unnoticed. The author has used the flexible speed of the film to good advantage, as in taking pictures in the hospital operating room under difficult conditions of light. All that is needed is a duplicate exposure of one shot. This film is then processed at normal times and temperatures. If exposure is not correct, developing times can be changed for the other films taken at the same time.

Fortunately the processing temperature of Ektachrome solutions (75F) is close to room temperature so that no water bath for the tank is necessary except during the hot summer months. We mix the solutions at the processing temperature and adjust any small changes in temperature that are necessary by stirring the solutions with a test tube full of hot or cold water as the need may be. In this manner we bring the temperature of the solutions very close to the tolerances recommended by the manufacturer. The wood tank acts as a poor conductor, thus preventing any sudden temperature changes. The tanks were built to hold one pint of solution and for five hangers each. To process 20 sheets of Ektachrome (3¼" x 4¼" size) in one pint of solution an increase in processing time is necessary for each subsequent five sheets of film (see Chart 1). The times here are those which are preferred by the author and should be used only as a suggested starting point for further variation.

The tanks are constructed of one-half inch white pine wood which is cut with half lap joints (see Fig. 1). The parts of the tank are glued together with *Cascophen*† glue and held in carpenters' clamps for 12 hours. No nails are used. After drying in clamps the tanks are coated inside and out with a water thinned coat of *Cascophen* glue and allowed to dry for 24 hours. It was found to be of definite advantage to coat the tanks completely with this glue since it allows the water-proofing paint to make a strong bond to the tanks themselves. After complete drying, the six tanks are mounted on a board in processing order, the sixth tank being used for the wetting agent. Three coats of *Phcote*** paint are then applied. The first coat is thinned slightly with turpentine and 12 hours are allowed for drying between each coat. Round head nails (X in Fig. 2) are put in the front of the tanks facing the processor so that the correct solutions can be verified by touch in the dark. One nail is used for the first developer, two nail for the hardener, etc. The tanks, as described have been in use for six years and are still in good condition. Although the tanks described here were made to accept 3¼" x 4¼" size film or smaller, they can be made of any size to fit particular need.

CHART 1

No. of Films	*First Developer* (minutes)	*Color Developer* (minute
[illegible]	[illegible]	[illegible]
10	10	1[illegible]
15	10½	14
20	10½	1[illegible]

*Received for publication November 2, 1956.

†Cascophen Cement made by Borden Co. Chem. Div., New York.

**Phcote Paint #15-312, Fisher Scientific Co., 711 Forbes St., Pittsburgh, Pa.

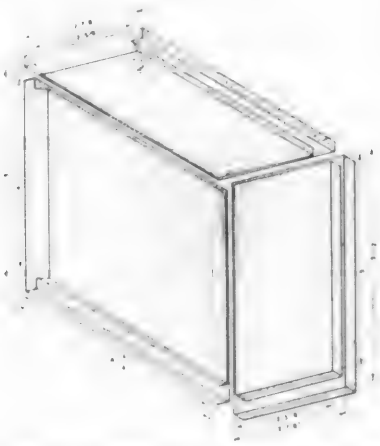

Figure 1. General construction of tanks. One end and one side are not shown.

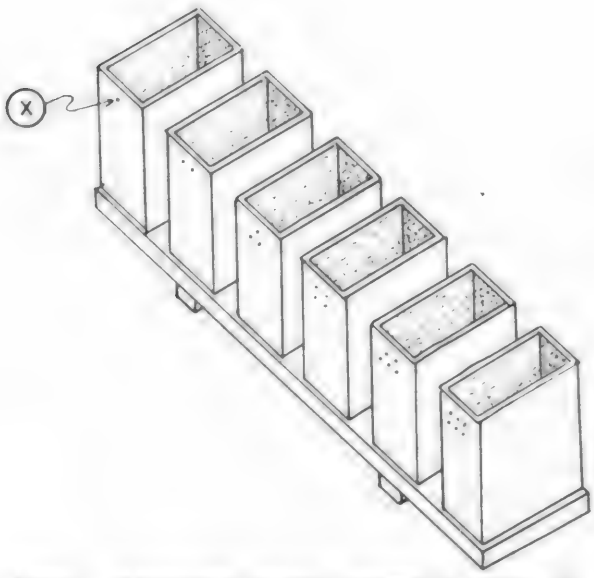

Figure 2. Arrangement of tanks as used by author. "X" points to round-head brass nails for identification of tanks in the dark.

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The Purpose of Textbook Illustrations

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Introduction

ONE picture is *not* worth a thousand words! A thousand pictures may not be worth *one* word! The textbook illustration must be worth *reading*. It must invite study rather than a casual glance. It must make a pictorial statement that is more lucid than it could be made with words alone. Both words and pictures are essential for good communication.

It has been said that ever since man first began to write he has been at a loss for words. True or not, in the beginning no words existed: so man drew pictures. These pictures represented objects with which primitive man was fully familiar. He learned to combine several of these object-pictures to express more complex ideas. Man's ability to read these pictures depended upon his knowledge of things around him and his ability to think.

For uncounted centuries man was forced to use knowledge gained from actual experience every time he attempted to think or express his thoughts to others. He gained his knowledge by physical contact with objects. He saw, he heard, he felt, he smelled — but he learned. Gradually it dawned upon him how these physical sense impressions could be expressed by vocal sounds — and the spoken word was born.

As language developed, writing became phonetic. We now write characters which represent sounds. The sounds no longer have a direct relationship to objects and ideas. We no longer think in terms of basic physical sense impressions. We think mostly in terms of words. When we try to tell others the full meaning of our own experiences — things we have seen or heard or felt — we discover that words alone are often inadequate.

Thinking in terms of words which are not founded on concrete experiences does not stimulate creative or critical thinking. It does not lead to the meaningful generalization and the practical application which is the purpose of learning. A good quiz memory or a large store of quotations is not intelligence. Adherence to group jargon is not understanding. This language handicap can be overcome in various ways. I suggest that we use pictures as a supplementary means of expressing our thoughts.

This is not easy for everyone to do, but there is hope for the future. Teachers are now using many new audio-visual means of communication, such as television and motion pictures. Our minds are being trained from childhood to think in terms of audio-visual images instead of depending entirely on words and numbers.

This visual thinking is creeping into professional education. It is important for us to know how to combine verbal and non-verbal means of expression in our textbooks.

It should be a challenge to you, as illustrators, to learn how to lead the authors and publishers of textbooks into joining visual and verbal expression into an integrated educational force. You must learn some of the principles of educational psychology, something of the methods of teaching and the psychology of learning. Then you must learn to apply these basic principles to illustrations in textbooks. These principles will also apply to your visual aids and television work. The challenge is there, and it is up to the illustrator to show the author and the educator how to apply visual expression to his problems.

Contemporary Educational Philosophy

Contemporary educators generally agree that learning evolves through a pattern of (1) setting an objective (2) actively participating in the achievement of the objective, and (3) evaluating what has been done in terms of the objective.

The teacher guides a group in discussion of what they want to learn about a broad subject, and the students set a purpose or goal. The teacher guides the students in selecting activities relating to the purpose. The students actively participate in the learning project. The students evaluate the results by group discussion and attempt to relate it to a broader field of learning, with the teacher's guidance.

Instead of aiming at knowledge for the sake of knowledge and storing the [illegible]

facts and scraps of information not readily usable, contemporary educators substitute dynamic, functionally useful learnings. The learnings are functional because they are acquired in terms of learner needs, by direct experiencing, and with awareness of a part-to-whole relationship of the facts, which are subject to change.

Education on a Professional Level

Most of the teacher educators of today recognize significant differences between teaching-learning technics of general education and professional education. Professions exist to transmit, interpret, and improve specialized aspects of the social culture, and the social responsibilities are such that they do social legal requirements for professional status. The ultimate goals remain essentially the same for both general and professional education, but the technics are adapted to meet the intellectual development of the learner and the socio-legal responsibilities of the profession.

Technics of professional education utilize more intellectual and less overt activity than on lower levels. Direct experience is always necessary for the acquisition of new skills not only motor skills, but intellectual, social and administrative skills as well. The ability to learn through indirect experience has increased as the student on a professional level has acquired a dependable body of related direct experience. So listening, observing, and reading play an increasingly important role in professional education.

Textbooks

It is important to remember that the textbook represents an abridged version of experience. Unless the student reader approaches the book with the necessary background of experience, he may fall into several traps. He may mistakenly believe that he understands the textbook discussion, or he may acquire the habit of accepting unthinkingly the verbal formulations of other people. The textbook is the historic companion of academic learning, but what is its function in the contemporary learning situation?

A superior learning situation has been described as a dynamic relationship between the learner and his environment which contains:

(1) an enriched contextual setting with which the learner can interact
(2) a central focus around which learnings can become organized
(3) a meaningful continuity or logical progression
(4) the prospect of an outcome personally beneficial to the learner and his environment

Particularly on the professional level where skills in vicarious learning are developed, the textbook or other technical literature can provide many of the requisites of a superior learning situation. Supplementary reading can enrich the contextual setting. The well organized textbook can become a superior element in focalization of learning (what am I expected to know?). Under the impetus of clinical experiencing the textbook serves to crystallize experiences, discussions, laboratory exercises, and reference readings. The textbook is also a ready reference for facts [illegible] the textbook in our educative process because [illegible] private reflection.

Textbook Illustrations

The basic objectives of a textbook illustration follow closely the basic objectives of a textbook.

1. to supplement verbal description with graphic definition of terms, objects, and facts—clarify, define, amplify, dramatize
2. to provide a central focus around which related facts can be organized
3. to demonstrate [illegible] relationships and meaningful generalizations
4. to provide an enriched contextual setting for facts or ideas presented in the text

Now we must consider what we are going to do about [illegible] their books.

First we must try to eliminate some bad habits which most authors have acquired. Picture one of the authors you know at his desk writing an article for his favorite professional journal. At one point he has some difficulty expressing the exact shade of meaning he needs to describe a situation. THIS is where he needs an illustration. But now is the time for him to think about it.

Tell him that he should conceive of the illustration while writing the text. Whenever particular difficulty is encountered in expressing his thoughts verbally, he should use a visual statement. A crude sketch is made at the

point and properly located in the manuscript will serve as an excellent guide for you when you prepare the illustration. This sounds absurdly simple, but how many writers will stop to do it? They usually wait until the article is written and then frantically search their files for illustrations, which they sprinkle like salt and pepper through the text. They can do the job with a few well-chosen, well-placed and expertly prepared illustrations. Irrelevant or unnecessary illustrations are an expensive luxury and seldom add anything to the effectiveness of the article.

Types of Illustrations

Tell the author to be on the lookout for situations which lend themselves to visual presentations. You should tell him something about the use of different types of illustration. For the sake of simplicity we can say that there are three basic types of expository illustration:

Pictorial illustration: Pictures of object
Explanatory graphic designs: diagrams
Mathematical diagrams: graphs

If the author keeps these basic types in mind [illegible] for visual presentation.

Pictorial Illustrations

If you need to use a picture of an object, [illegible] lose to pictorial reality as possible. By using a photograph of an object in its natural environment you can provide a fair substitute for actual experience for the reader. For example, [illegible] as any of us will ever get to seeing a mother [illegible] it's just as well.

With a picture of an object you can supply the context for the principal statement you [illegible] evidence in the form of photographs. (Figure 1) Another useful function of factual illustration is the demonstration of facts not readily perceived, such as complex anatomical relationships. (Figure 3) A realistic, or pictorial [illegible] reader benefits by seeing objects in their natural surroundings. When the complexity of detail threatens to obscure the important features, however, an attempt must be made to [illegible]. Simplifications can often be achieved by photographic methods, but usually it is [illegible] tures in the form of a drawing.

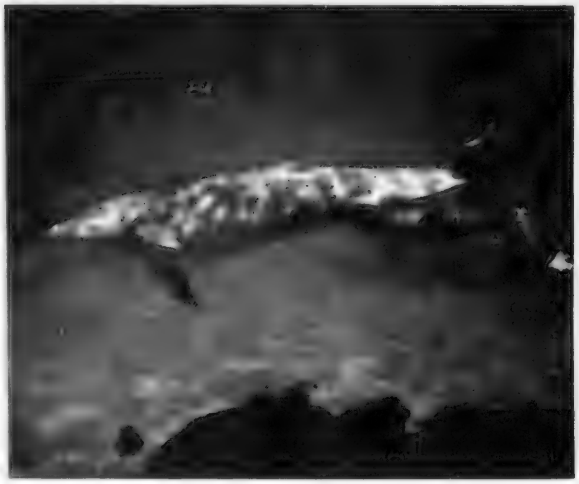


Figure 1.

Figure 2.

Figure 3.

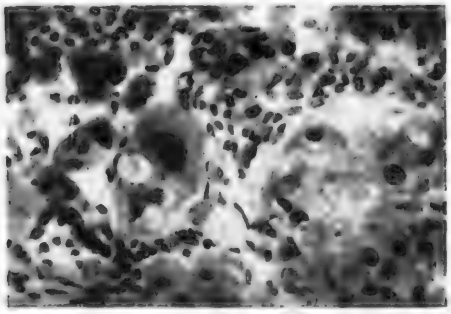


Figure 4.

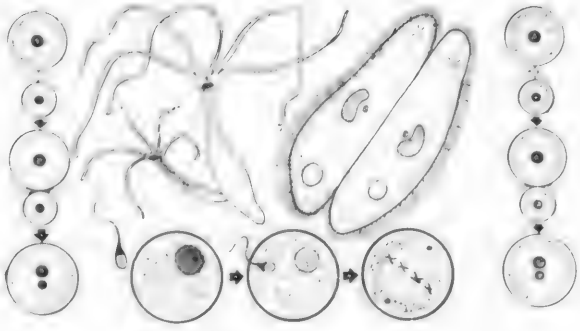


Figure 5.

Very often facts which are abstract or intangible can be demonstrated by the arrangement of photographs or drawings, which themselves represent concrete objects. Factual, or pictorial, illustration also may serve the important function of defining objects not normally visible, such as microscopic structures (Figure 4) or objects of such magnitude as astronomical configurations.

A central focus may be provided graphically by chapter-heading or unit-heading illustrations to define the scope of that particular section. (Figure 5) Usually a key idea or fact predominates in a chapter. These illustrations should point out the part-to-whole relationships, but should definitely emphasize the key subject. This function of illustrations can be very useful as far as the teaching value is concerned and also can be very decorative and create a pleasant reader reaction. Visualize what could be done with a montage of photographs used instead of the drawings in Figure 5.

Diagrams

Explanatory graphic designs, or diagrams, are idea drawings. They are simple statements containing only enough detail to cause the reader to perceive the generalization

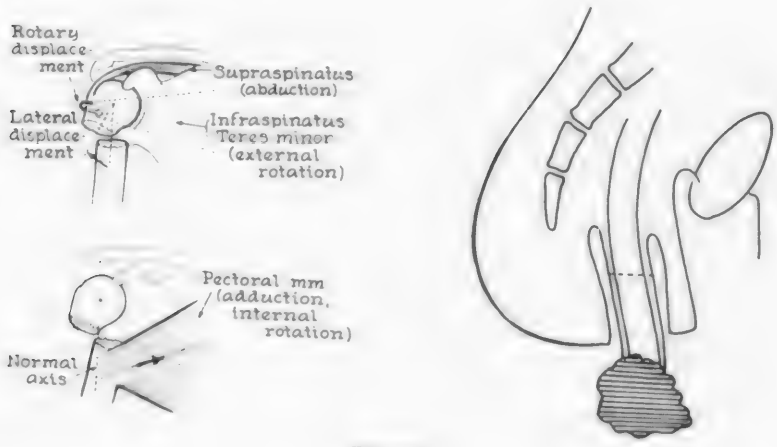


Figure 6.

which you want him to see. By extreme simplification you can demonstrate relationships of facts which are otherwise not apparent. Figure 6 contains three very simple diagrams. The first two show the relationships of muscle and bone around the shoulder joint. Only the muscles which cause certain displacement following a fracture of the humerus are shown. The third diagram is an extremely simplified representation of an intussusception of the colon with the tumor and line of resection indicated. In this picture there are no details to interfere with the reader's rapid comprehension of the generalization: (tumor-intussusception-resection)

A diagram can be the catalyst (Figure 6) which helps to crystallize a generalization in the mind of your reader. You can use simple diagrams to provide graphic description of processes and functions which are otherwise intangible and abstract concepts. On Figure 10 are three examples of explanatory graphic designs. They represent attempts by three different authors and illustrators to explain the basic pathological picture of the Tetralogy of Fallot. We will consider which of these is most effective in a moment.

Stereograms, or three dimensional diagrams, are useful in describing objects rarely seen in three dimensions, such as microscopic anatomy. The well known anatomist-artist, Hans Elias, has made many excellent three-dimensional projections of microscopic anatomy, descriptions of something which is almost impossible to describe with words alone.

Diagrammatic illustration does not exclude photography. If you use a little ingenuity and imagination you can devise means of using photography in unusual ways to tell your story. Use "exploded" views of instruments or laboratory apparatus, or multiple exposure action photographs. Often you can combine several objects not usually seen together to tell a story more effectively than if you used the elements separately. Figure 7 shows a grouping of Roentgenogram, electrocardiogram, gross specimen, and microscopic section. Results: You have told the complete story at a glance, in a minimum amount of space, and you may have helped the reader to arrive at a meaningful generalization.

You must never take it for granted that every reader will understand the diagram you use. Diagrams are by definition the barest skeleton of an object or a process. Sometimes they should be used with a photograph of the original, for the visual symbol may be misunderstood. It is wise to begin with the original or a photograph of the original and gradually work toward the diagram. Students on higher levels, however, have developed certain skills in interpreting symbols.

Graphs

The third basic type of expository illustration is the mathematical diagram, or graph. When you can translate complex information into mathematical terms you can summarize it graphically. You can organize the facts in

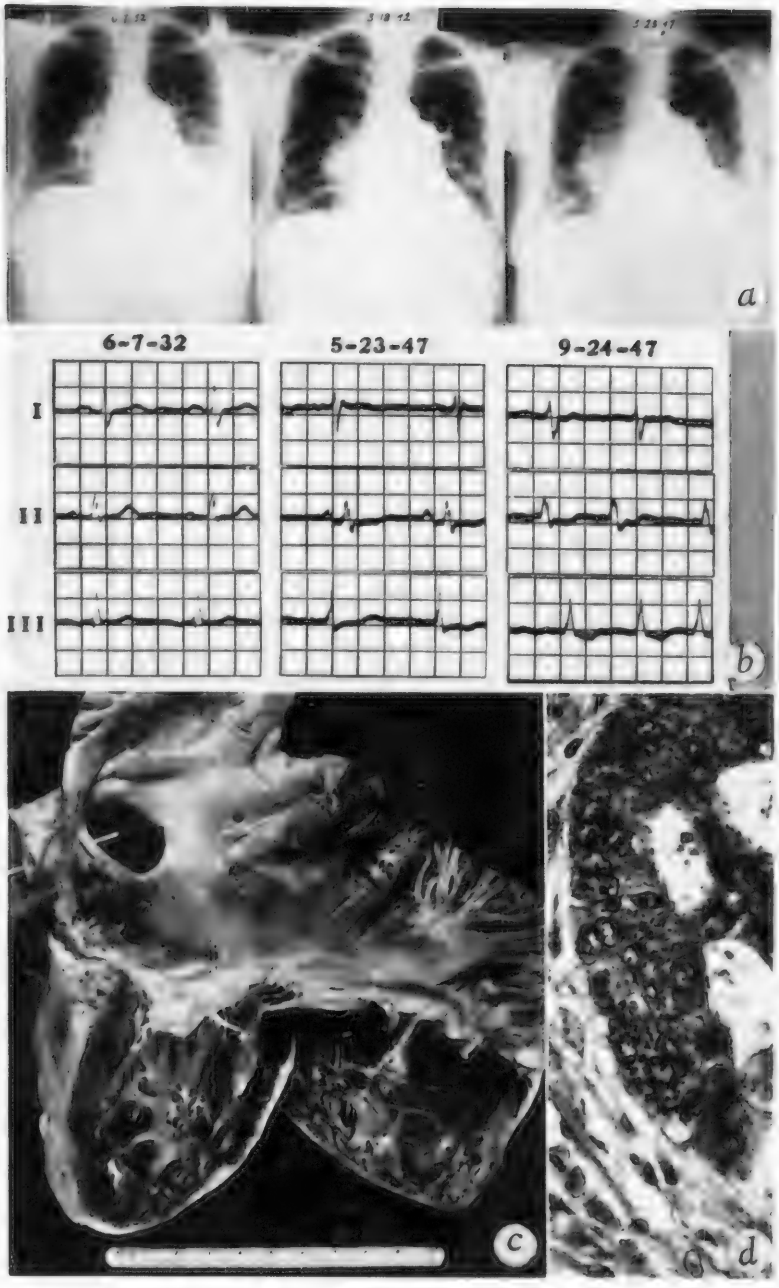


Figure 7.

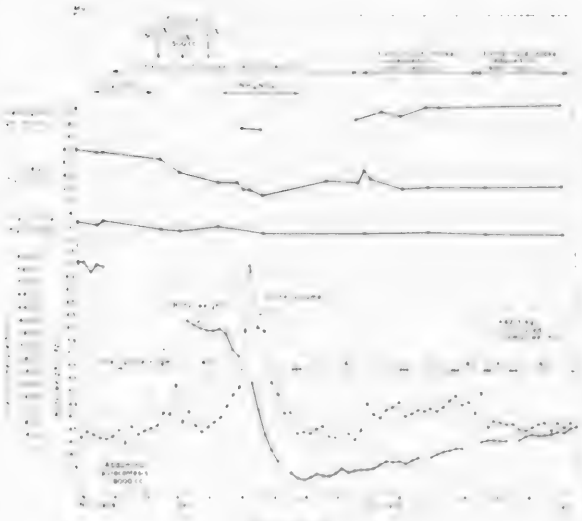


Figure 8.

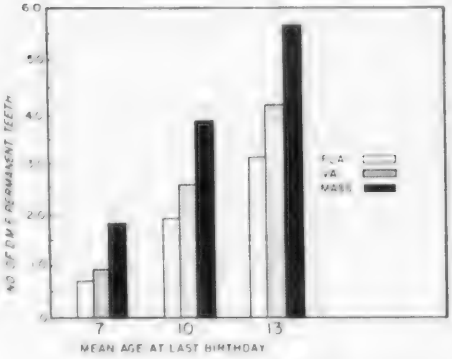
a manner that will emphasize the general relationships and the useful aspects of the subject

The purpose of a graph is simplification, and too much information on a graph defeats that purpose. You should make every attempt to simplify the graph. A great deal of complex information has been simplified and presented graphically in Figure 8. If more simplification is possible, the graph can become even more effective. (Fig. 9)

You can now acquaint your authors with the three basic types of expository illustrations: pictures, diagrams, graphs. You can show them how to recognize situations which usually need illustration, but just because you convince them to put illustrations in their books does not mean the illustrations will be functional parts of the learning situation. What does make an illustration functional? How do we evaluate the usefulness of an expository illustration?

Evaluation

We evaluate illustrations for scientific publications according to three general qualities in about this order: *teaching effectiveness, suitability for reproduction,* and *artistic merit* You and your author and your publisher should consider carefully each illustration to determine its usefulness. Throw it out or revise it if it is not doing the job it is



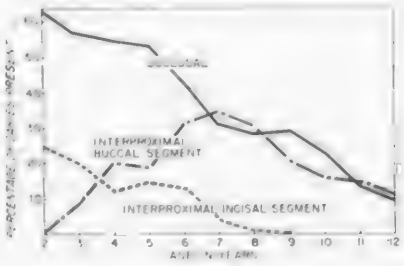


Figure 9

Teaching Effectiveness

Teaching effectiveness implies a lesson to be taught: you want to [illegible] a fact, a thought, a [illegible] interpretation. The [illegible] tion in accomplishing this can [illegible] measured subjectively. However from experience we know of [illegible] generally contribute to better understanding of an illustration by the reader to whom it is directed

You must [illegible] the basic point in [illegible] make that statement paramount. You must assess the past experience of your reader and direct the visual statement to his level of experience. Include only as much detail or orienting matter as you feel is necessary to provide the context for your principal message. Emphasize the principal statement and subordinate the rest.

The parts of the illustration must be well [illegible]

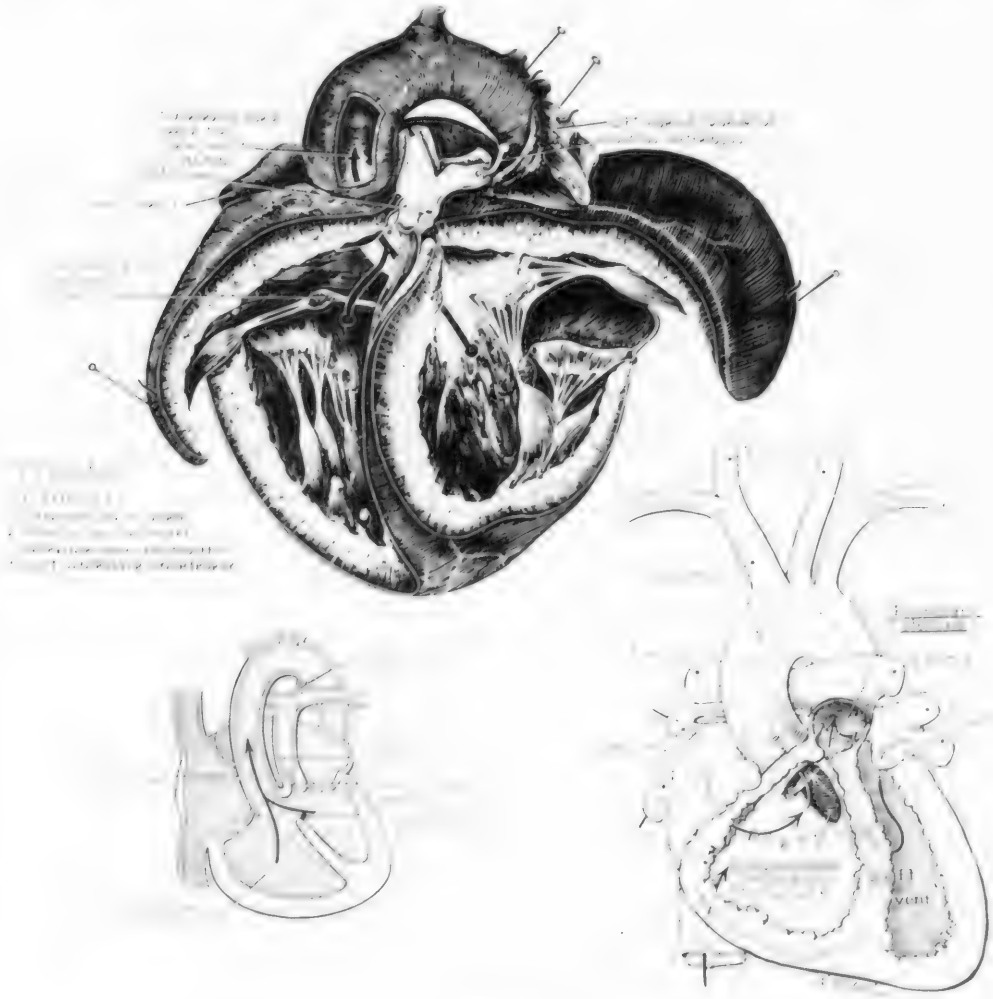


Figure 10.

them. The parts must be arranged logically so that they lead the reader to the desired conclusion. Let's look at Figure 10; three methods of picturing the *Tetralogy of Fallot*. The first, a drawing of the gross specimen, is ineffective because the complexity of detail obscures the pathological picture. A photograph of the specimen would have somewhat the same deficiencies. The small diagram in the lower left corner is intermediate in effectiveness. The over-simplification in the diagram could lead to misinterpretations, especially in the region of the septal defect. The third example, lower right, combines the best characteristics of the first two and rates superior in teaching effectiveness. Notice the treatment of the aorta where it overrides the septal defect. The anatomical relationships are pictured in a simplified, but accurate way. After these examples, you should recognize the factors which influence the teaching effectiveness of an illustration.

Suitability for Reproduction

The second most important point to which you must explain an illustration for publication is its suitability for reproduction. Many illustrations lose their effectiveness when reduced in size and reduced to the limitations of photomechanical reproduction.

How can you be certain that your illustration will be suitable for photomechanical reproduction? You can do this by paying close attention to certain qualities of the illustration and the context in which it is presented to the publisher. Publishers usually can make several suggestions which help to make an illustration suitable. But they only can do so if you consult with them about the illustration before you make the illustration.

The limitations of the halftone process and printing in general come mainly from the inability of reproduction machinery to photographically reproduce all tones. There is one limitation, however, which is usually overlooked. The quality of paper used in books and journals greatly affects the quality of halftone printing. Paper is manufactured in various degrees of smoothness and absorbency. If the printer is forced to use the most absorbent paper, he is consequently unable to print as fine a screen as with harder, smoother paper. He must use a halftone screen with fewer dots per inch because the ink spreads in the pores of the paper and fills in between the impressions of the dots.

For books and journals published cheaply, an inexpensive paper which is fairly smooth to the touch and has a dull finish is used. Illustrations in such publications are usually printed in 100, 110, or 120 halftone screen. Slightly better paper is used for publications which are printed on a press capable of printing finer screens. Publications printed on the best coated paper depend largely on the interest in the subject. However, the coated papers are thicker and more reflective, and more expensive, as the coating gets harder. Therefore, the publisher must reach some compromise between the complexity of the type, eyestrain of reader, bulk of the book, price of the book, and the quality of halftone reproduction.

I will make a few comments on the ways to overcome halftone problems for the publisher and photographer. photomicrographs and reconstructions. When you decide to use a photomicrograph, select the essential features on the photograph, crop it, and mark the area with a grease pencil. A smaller field will mean less reduction of the important

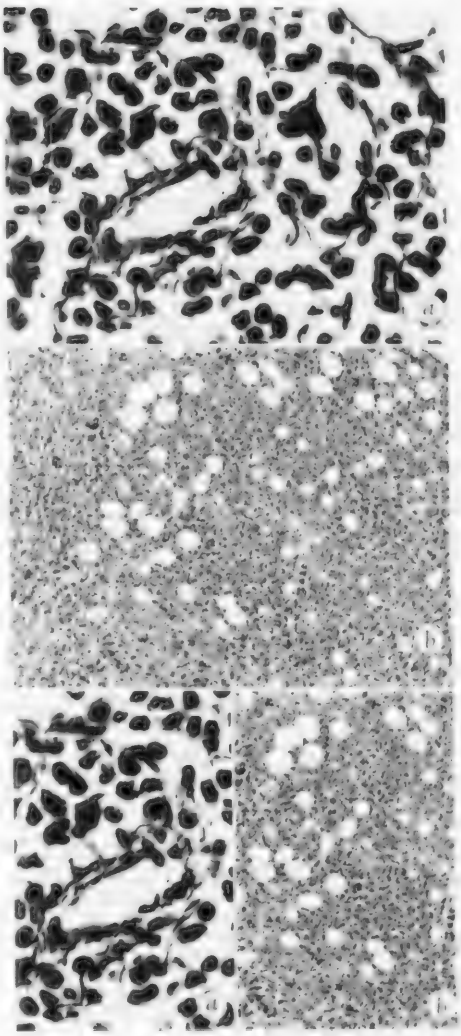


Figure 11.

area. You can use small high-magnification pictures as inserts, or in combination with [illegible] or with [illegible]. Figure 11 shows an [illegible] The [illegible] which [illegible] the [illegible] and [illegible] the most detail in [illegible] the [illegible] reduction in the printed [illegible].

The [illegible] can submit [illegible] Overall [illegible] prints, that is, [illegible] the [illegible] on the film. To do this you must make an

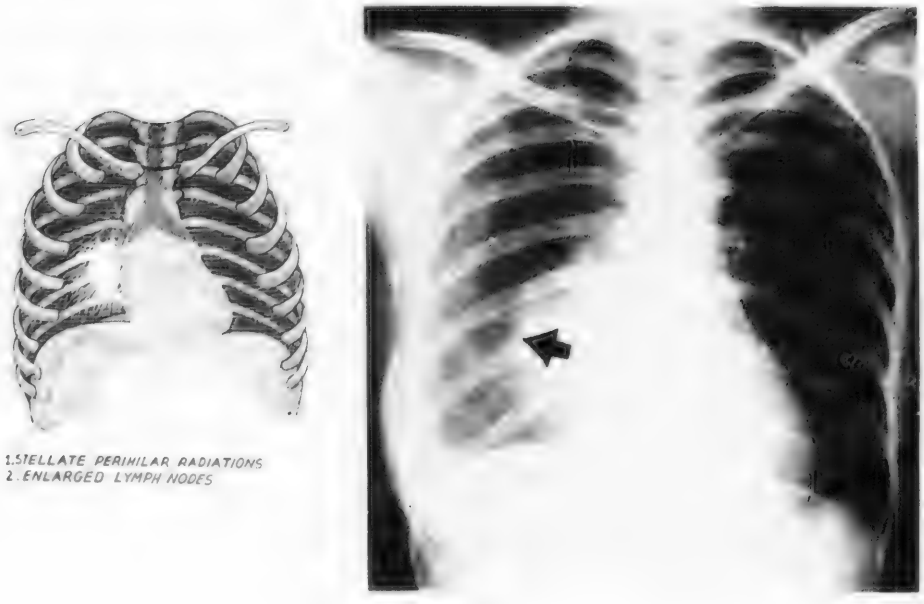


Figure 12.

intermediate negative. The general qualifications of a good print for reproduction apply also to copies of roentgenograms. Concentrate on detail in the important area.

Slight differences of tone, evident enough on the original films when you view them by transmitted light, may actually be too subtle to survive halftone reproduction. Add arrows or other devices to point out the important areas, as shown on Figure 12. In many instances the only solution to the problem of reproducing detail in roentgenograms is to make a line tracing in pen and ink. You will be commended for preserving authenticity only when the facts you are trying to show can be seen. Personally, if I can't see the details, then I would rather have your version of them in a line drawing.

Artistic Merit

I have spoken of teaching effectiveness and suitability for reproduction. We now come to the third point in the evaluation of an expository illustration, artistic merit. This rather intangible quality can have a negative or a positive effect on both of the other two qualities.

For your illustration to be functional, it must challenge the attention of the reader. To do this, an illustration must be attractive and interesting. The design, or the manner in which the facts are selected or arranged, and the technic of drawing or lighting will influence the reader's attention. Arrange the parts of the illustration in an interesting visual pattern and logical sequence. Use neat lines and pleasing shapes. Often the simplest visual statement, unadorned with extraneous detail, can be attractive because of its simplicity.

Frequently, however, the purpose of an illustration calls for a detailed treatment. Perhaps details of structure, or surface texture are necessary to tell the story or to make it more convincing. In a drawing you can select these details discretely. Do not use a detailed treatment indiscriminately over the entire picture. In a photograph you can insure visualization of details by enlarging the important area as much as possible, eliminating the unnecessary portions. You can adjust the lighting of the subject to emphasize the details of surface texture and structure.

It is often possible to create an impression of detail without destroying the emphasis on the important feature of the illustration. Keep the detail subordinate to the primary story. An accurate, convincing representation of ob-

jects, regardless of detail or technic, is a primary requisite of any scientific illustration.

Conclusion

Unless photographs and drawings are made specifically for their purpose in a book and conceived of while the author is trying to express that purpose verbally — they are almost never precisely functional. The well advised author collects his illustrations while he writes his manuscript. He obtains clean sharp photographs and drawings. He delivers them properly grouped, mounted an captioned.

One day some author is probably going to do just this and make his publisher very very happy. That will be the day that some of us will arrive late to work because of an ice jam on the River Styx.

CREDITS

Figure 1 — Marine Studios, Marineland, Florida.
Figure 2 — W. A. Osburn, unpublished.
Figure 3 — Richard M. Hewitt, M. D. *The Physician-Writer's Book* W. B. Saunders Co.
Figure 4 — W. A. Osburn, unpublished.
Figure 5 — Alfred M. Elliott *Zoology* Appleton-Century-Crofts, New York.
Figure 6 — Paul Williamson, M. D. *Office Procedure* W. B. Saunders Co.
Figure 8 — Richard M. Hewitt, M. D. *The Physician-Writer's Book* W. B. Saunders Co.
Figure 10 — William B. Bean, M. D. Iowa City, Iowa.
Figure 11 — Sidney B. Finn, D. M. D. *Clinical Pedodontia* W. B. Saunders Co.
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Journal of the Biological Photographic Association Vol. 24, Nos. 3 and 4 August-November, 1956

Some Footnotes on Photography's Place in Medical Illustration

C. GRAHAM EDDY

PHOTOGRAPHY is a prominent and a magnificently important part of medical illustration—but it is a part and should be considered in terms of its relationship to the total field. In examining medical illustration, a kind of mental ballast is needed in the form of a definition which encompasses the whole field. One such definition states that

> Medical illustration is planned communication, a necessary and integral function of any fully developed medical program. The specialized skills of the illustrator and the physician are blended in the medical illustration laboratory to produce, through a variety of media, [illegible] of medical information in comprehensive, concise, and realistic form.[1]

Medical illustration is an art practiced by relatively few people, and it is virtually unknown to many who do not in some way contribute to the practice of medicine. Indeed, some who profess more than a casual interest in medical illustration frequently underestimate its scope. All media lending themselves to the creation of visual impressions belong among the armamentaria of the medical illustrator, and in recent years, devices for recording and recreating aural impressions have been added. The scope of medical illustration is truly broad. It is limited only by the imaginations of those engaged in its practice and in its utilization.

It is interesting to observe how far into antiquity medical illustration penetrates, and to locate some of the significant events between then and now. An orderly observation of these events emphasizes photography's growth in importance through its steadily increasing utilization in medical situations.

Medical illustration's earliest forms are found on ancient stone fragments and on the walls of caves, while Egyptian papyri bear the earliest transportable records of illustrated medical information. Such pictures, crude as they may seem, were not capriciously created by untrained artists. They are carefully, and often artfully, constructed schema which were used to illustrate coeval medical knowledge. Medical art, although very crude and inaccurate in its beginning, has, throughout the ages, gradually developed in the minds and hands of artists who were medically informed and who had the desire to record and transmit medical knowledge. Each moved a step at a time away from grossly inaccurate schema toward anatomical truth.[2]

Early 14th and 15th Century anatomical figures fail to show more than crude artistry or anatomical accuracy. Since the Church disapproved of human dissections, they were performed hastily and in secret to avoid discovery. The early dissectors, untrained artists at best, lacked enough daring to risk discovery by sharing their guilt with skilled artists.

The first artist to produce outstanding anatomical illustrations was Leonardo da Vinci. Unfortunately, not one of his finished plates was published. They were prepared around 1508-1512 for an anatomical text by the anatomist, Marcantonio della Tora. Marcantonio, however, died from plague in 1512, and his projected publication died with him. Although Leonardo's plates have never been found, many of his superb sketches were preserved, and in recent years, these have been reproduced.

An outstanding feature of Leonardo's illustrations is his break with tradition. He usually drew what he saw, rather than what someone else described or what he imagined. There is ample evidence in his drawings that he made them from personal observations. Furthermore, it is known that he prepared many of the dissections himself.[3] Tom Jones, today's dean of American medical illustrators, states, "He was one of the earliest advocates of graphic illustration and probably the first great 'expositor' of the structure of the human body."[4] Leonardo's careful regard for the accurate representation of truth remains a

[1] "Medical Illustration: An Essential Factor in Modern Medicine," exhibit, presented by the Veterans Administration at the 59th Annual Meeting of the Association of Military Surgeons, Washington, D. C., November, 1952.

[2] "A Tribute to the American Medical Artist," pamphlet (Minneapolis: Modern Medicine, 1946), 1.

[3] J. Whillis, "Anatomical Illustration," *Medical and Biological Illustration*, 1:66-73, April, 1951.

[4] Tom Jones, "Via Optica," *Quarterly Bulletin* (Northwestern Medical School), 20:71, Spring Quarter, 1946.

primary precept of medical illustration, regardless of its medium of expression.

The anatomist, Andreas Vesalius, born in Brussels in 1514, five years before Leonardo's death, is regarded by many as the father of medical illustration. Medicine, being deprived of the fruits of Leonardo's work, turns to Vesalius as a matter of course. His great work *De Humani Corporis Fabrica*, stilled forever the fanciful anatomical descriptions which had been current since the time of Galen. So meticulous was Vesalius that he personally prepared the dissections for van Calcar, his artist supervised the making of the illustrations; and spent nearly a year superintending their printing.[2] The first edition of the Fabrica was issued in 1543 from the press of Oporinus in Basil. The second edition, better and more widely known, was also published in Basil. It appeared in 1555.[3]

Following Leonardo da Vinci and Andreas Vesalius, many illustrious European artists and anatomists added to the store of visually recorded medical knowledge.[4] But in the United States, as late as the end of the 19th Century, artists who illustrated the medical books and journals, appear to have had but scant knowledge of art and less of medicine. It was not until 1911, when Max Brodel came from Leipzig to the Johns Hopkins Medical School to teach medical art, that there began to prevail in this country a true conception of the specialized knowledge and skill which the preparation of a medical illustration requires. Evidences of his electrifying influence are seen again and again in the superior work of medical artists, who, for thirty years, came from all over the continent to study under his guidance.[5,6]

Prior to the advent of photography, all illustrations were reproduced by engravers or lithographers. More often than not, these were craftsmen who prepared plates from the original drawings of others. Since every artist's illustration was necessarily his interpretation of what he saw, the chance of error was always present, and the engraver or lithographer frequently introduced additional artifacts. Consequently, many attempts at medical art failed to satisfy medical requirements. It is small wonder that, immediately after its invention, photography was embraced by science as an objective method of producing scientific records.

Although the birth of photography is usually associated with Louis Mande Daguerre when he announced his fixed image in 1839, others before him had made significant contributions. Notably, there were Thomas Wedgewood and Sir Humphry Davy, who produced silver-nitrate-coated paper and glass in 1802; Johann Heinrich Schultz, who, in 1727, observed the action of light on silver chloride; and Leonardo da Vinci, who described the phenomenon of the camera obscura.[10]

Three hundred and fifty years passed between Leonardo's observations and Daguerre's permanent photographic image, but in February, 1840, a short six months after Daguerre's achievement, Doctor Alfred Donne produced a daguerreotype photomicrograph which he called a "microscopic daguerreotype." This is generally conceded to be the first true medical photograph. From this era, there are no known examples of photographs of morbid phenomena or clinical findings, probably because of technical inferiority applied to corrected lenses and exposure times were not available until toward the end of the century.

Johann Czermak unsuccessfully attempted photography of the larynx in 1860, but Thomas French solved the problem in 1861, thereby producing the first clinical photographs.[11] From then on, progress in improving photographic instrumentation and techniques was steady. Science, and especially [illegible] enjoyed the privilege of a

J. Whillis, "Anatomical Illustration," *Medical and Biological Illustration*, 1:66-73, April, 1951.

[2] Barry J. Anson, "Anatomical Tabulae and Initial Letters in Vesalius' Fabrica and Its Imitative Works," *Surgery, Gynecology and Obstetrics*, 89:1-30, July, 1949.

[3] During this period, there was also a surprising amount of unintentional medical illustration resulting from the faithful portrayal of model [illegible] defect. Interesting accounts may be found in Lucy Ruhrah, "Pediatrics in Art," *American Journal of Diseases of Children*, a series of forty-eight items, one appearing in each issue of vols. 44-47, 1932-1933; and Carl D. Clarke, *Illustration: Its Technique and Application to the Sciences* (Baltimore: John D. Lucas Co., 1939), pp. 25-52.

[4] *A Tribute to the American Medical Artist*, pamphlet, Minneapolis: Modern Medicine, 1946), p. 1.

[5] Thomas S. Cullen, "Max Brodel, 1870-1941, Director of the First Department of Art as Applied to Medicine in the World," *Bulletin of the Medical Library Association*, 33:1-29, 1945.

[6] Beaumont Newhall, "A Brief History of Photographic Techniques," *Ciba Symposia*, 4:1389-1402, September, 1942.

[7] George Rosen, "Early Medical Photography," *Ciba Symposia*, 4:1544-48, August-September, 1942.

[illegible] applied and relatively [illegible] in the production of single or multiple records of physical phenomena.

While Thomas French was successfully making photographs through the laryngoscope, Etienne Jules Marey was unintentionally laying some of the ground-work for motion pictures by attempting to analyze human and animal movements by serial photographs.[12] Leland Stanford, when he was Governor of California in 1881, is believed to have seen some of Marey's serial pictures. He induced Edward Muybridge, head of the photographic department of the State Surveyor's Office, to undertake studies of horses in motion. Muybridge set up twenty-four cameras in a row and arranged for them to be triggered successively as a horse galloped past them. Later, he employed more than one such battery of cameras and eventually applied the same technique to human motion.[13]

Marey's prime interest was the study of motion under a variety of circumstances, and, while he carefully followed Muybridge's work, he showed little interest in synthesizing series of single pictures into a motion picture. This he regarded as having amusement value only. He went on to record serial images on a single photographic plate. He created numerous kinds of chronophotographs, and eventually, in 1890, constructed a cinematographic projector.[14] Today, the medical photographer uses the multiple flashes of a gaseous discharge lamp to record serial images on a single plate. These modern, highly refined "chronophotographs" are employed wherever accurate records for the study of motion are required. It is interesting to note this endurance of a basic procedure, when from it there have been developed the intriguingly diversified and complicated [illegible] techniques used in producing modern motion pictures.

From the turn of the century to the present time, photography has developed rapidly. Its advances have been too numerous, as well as too intricate, to describe in detail. Physicists have derived formulae by which there are now produced lenses which exceed, by far, the dreams of early photographers. Chemists have produced photosensitive film coatings capable of recording images from well below to well above the visible spectral range. The combined resources of optical, mechanical, electronic, and photographic engineers have devised cameras and associated instruments capable of producing a tremendous range of physical recordings. Endless combinations of these and other resources make it possible to produce records of situations not only seen and heard, but of phenomena hidden from unaided human observation. Infrared and ultraviolet photography, ultraspeed and slow-motion pictures, electron photomicrography, and television are a few of the means used by today's medical illustrator to assist in extending the practice of medicine.

From this rich heritage of the past 117 years are assembled the wide array of talents, techniques, and media on which modern medicine depends for most of its graphic representations. Brodel, with all his brilliance and creative imagination, had little use for photography. His concept of serious medical illustration had room for only the trained artist' unerring power of observation and interpretation. He said, "[illegible] an artist feels degraded when he copies or uses a photograph as a basis for his drawing."[15] Although he taught this concept, and some of his students continue in its belief, its force is diminishing.

The talents of the artist alone can never meet the total demand of medicine for illustrative materials. His powers of observation and interpretation have limits beyond which photography and related technology are able to penetrate. While the artist will always be preeminent in some fields, there are other areas of illustration within which the photographer can move with equal, if not greater, facility and with greater economy. Thus, throughout the spectrum of medical illustration, there are readily recognizable bands of specialization which may fade into or overlap other equally specialized bands.

The preparation of an illustration should be governed by the end product sought, and by the circumstances of its production. Too often, however, there is less interest in what is to be accomplished than in how it is to be done. Medical artists, bio-photographers, re-

[illegible] "Technical Advances of Physicians," *Ciba Symposia* 3:1034-52, July 1941.

[illegible] H. Gurtner, "Etienne Jules Marey and Edward Muybridge, Pioneers in Motion," *Ciba Symposia* 4:1351-61, August-September, 1942.

[illegible] Gurtner, *opp. cit.*, pp. 1358-59.

[illegible] Cullen, *opp. cit.*, p. 25.

lated technicians, and the physicians they serve all tend to be independent thinkers. Each frequently is convinced that he, alone, can bring to an illustration problem the key to its solution.

This is not surprising. The physician, with his inquiring mind and his desire to impart new knowledge, created the need for medical illustration. The artist, attempting to fill this need since before the days of Leonardo, has served for hundreds of years in an irreplaceable capacity. The newcomers of the past 117 years, through their skillful employment of the technical advances of science, have also established themselves as irreplaceable medical illustrators. Gradually, the requirements of medical illustration[1] have drawn together a variety of unmistakably related functions. But the cohesive forces of these functions have been cupped through traditional habits and prejudices. It is only in recent years that all the elements of medical illustration could be found in a single laboratory. In most places, the modus vivendi has been art and photography, if indeed, it were not art versus photography.

Less than two generations ago medical illustration was considered only a peripheralized, creative art, not amenable to the formation of professional societies, systematized production departments, or division into tasks of varying levels of difficulty. There was only one goal—mastery and performance by each illustrator of all tasks in the process of producing an illustration. Fortunately, this guild concept is fading. The introduction of new techniques, requiring specialized knowledge and skills, has begun to force the concept of medical illustration into new patterns. One of these new patterns is marked by the realization that medical illustration can flourish as an organized entity without losing its consider its individualistic character and creative force.

Some institutions have not yet recognized this omnibus concept of medical illustration wherein are gathered many specialized, complementary talents and media of expression. On the other hand, an increasingly large number of medical organizations have overcome their inertia. They are finding in medical illustration's inter-related parts a lively force which supports better research, more effective education, and which assists other segments of modern medical practice as well.

[1] *Cf.* definition, p. 1.

The direct contributions of medical illustration to research and education are fairly obvious. Also easy to recognize is its value in connection with providing a natural and dignified manner through which the achievements of its supporting physicians and institutions can be made public. In addition, medical illustration is of direct benefit to patients when the illustrations themselves are employed as diagnostic and therapeutic aids. Furthermore, availability of medical illustration facilities in an institution is a [illegible] in the recruitment of high calibre physicians, as they become more and more accustomed to using audio and visual aids.

Medical illustration is in the midst of a quiet revolution. Characteristics traditionally considered idiocratic are beginning to appear as reflected attitudes toward the art rather than traits derived from within it. Artist-photographers, and other specially trained workers in related fields are now able to acknowledge overlapping and mutually supportive areas in their respective fields without an accompanying sense of violation to creative individuality. These are the things which characterize this quiet revolution and make possible the serious attention now being given to the management of medical illustration as a group of activities which are related through their common purpose of imparting medical knowledge.

Summary

The origins of medical illustration are [illegible] bedded in ancient history. Wherever an inquiring mind met new medical knowledge, inevitably there seemed to develop an urge to translate that knowledge into some graphic form. As graphic skills developed, the concurrently developing store of medical knowledge [illegible] graphic representations.

Scientific discoveries in other fields than medicine created wonderfully effective aids [illegible] medical or [illegible] graphic [illegible] [illegible] these. The discovery [illegible] [illegible] [illegible]

[illegible] has been phenomenal. And the process has not ceased. Further refinement, development, and new discovery are going on in numerous laboratories daily.

The human side of this growth is interesting. Because of the jealous protectiveness most workers exhibit toward their [illegible] media of expression, a true molding of complementary and supporting processes has been delayed. Furthermore, a high degree of individualism has hindered cooperative effort and free exchange of ideas among careerists in medical illustration.

Fortunately, the tide has shifted. Professional associations for workers in medical illustration have been formed. Large institutions are supporting medical illustration laboratories, employing illustrators as groups instead of as independent workers. Now, finally, there is an initial acceptance of the principle that the practice of creative art and the practice of good management are not mutually exclusive.

Journal of the Biological Photographic Association Vol. 24, Nos. 3 and 4 August-November, 1956

Scientific Education and BPA*

H. LOU GIBSON

THE important technical phases of biological photography have come in for well-merited attention at this Meeting. But the Program would be one-sided if we did not examine also the applicational aspects. This session tonight is therefore devoted to an exploration into some of the ways to make the most efficient use of photographs in imparting biological information, particularly in the educational provinces. And we shall study some of the abilities that should be taught the progressive future BPA Member along technical and administrative lines.

This has a bearing on the criteria for accrediting medical photographers—a topic that has received careful attention at this Meeting. However, such measures deal largely with *how* the photography is to be done, whereas we also want to consider *what* the field of biological photography is going to encompass.

The science of "visual education" is outgrowing its label. It never has supplanted auditory teaching—but certainly has nobly supplemented it. Then, too, there is the value of the directed tactile and proprio-perceptive experiences of manual practice that enter into many efficient training processes. And, the senses of smell and taste, which now have a rather limited application in the teaching of chemists and would-be brides, may represent a relatively untapped potential. For example, a waft of new-mown hay in an urban school-room—a whiff of [illegible] rural counterpart could be quite educational!

This is a bit far-fetched but it emphasizes the need for a new label to indicate a "panstimulus education" for utilizing all portals to the intellect. There is already a new appraisal of teaching "aids" of all kinds going on. This is calling for a particular kind of professional outlook that, as yet, has scarcely begun to crystallize. Neither its genesis nor direction is clearly defined. To bring this matter of the "learning-stimulus coordinator-director" (for lack of a better generally acceptable term) closely home to the BPA we can appreciate that photography is going to play an indispensable part in the preparation of the major teaching aids—those of a visual nature. We are then entitled to ask the following question: Is this new director of such programs going to arise out of the biological photographic field, out of biological scientific circles, or out of colleges of education?

Before we attempt to discuss a possible BPA answer, we can narrow down the consideration even more and ask this: Is the medical photographer going to tell the medical instructor when and how to use photography? Obviously, only a rather special and rare kind of photographer is going to do that. Suggestions on photographic aids can be given by photographers but they are hardly trained to direct educational methods.

It all reduces to the fact that photography as a skilled biological *technique alone* is hardly a profession. It is in the degree to which the technician influences the *effective use* of photography that he becomes a "professional man." And it is only by somehow acquiring a professional status from education or experience that a photographer can become the type of educator we are discussing and can direct a phase of professional activity for other professional men. As Tom Jones pointed out to this Meeting last year[1], the term "biological photographer," needs enlarging. That is true, but I would add that the image must stay in focus.

It is clear that not all biological photographers are educated such such positions or even want to take on such responsibilities. Scientific photography is a satisfying art in itself. There is a great need for additional proficient photographers to make the photographs for our new director. They will furnish a steady progress in the efficient, conservative use of photography, because revolutionary methods are not going to be adopted over night. Such progress, worked out and disseminated by the BPA, can well raise the over-all average of photographic utilization. The character of our Journal is flexible enough to bring biological and medical illustration to biologist and [illegible]

*Presented at the 26th Annual Meeting.

[1] Jones, Tom: The Role of the Photographer in Medical Education. Jour. BPA, Vol. 23, No. 4, November, 1955.

Our experience will also serve as a guide for those institutions that will not be in a position to inaugurate full and elaborate systems for propagating photographic aids. For example, many progressive general hospitals, while not associated with medical colleges, are offering formal postgraduate instruction to interns in addition to training programs for nurses and orderlies. They have directors of education who will want to operate as efficiently as possible in their particular educational programs. Therefore, the BPA need not feel that it should essay to make all its members educational experts there is still going to be room for photographic experts.

Nevertheless, some sort of a transition seems inevitable. The BPA should be cognizant of the trend, because it will be affected in three major ways. First, some of our members do have the background, ability, and desire to grow into these educational advisory and directive offices. They are already performing some of the professional duties envisioned here. They will want to advance to meet the growing need. This is especially important, since the scientific circles and education colleges have not yet themselves produced the particular directors that seem to be called for. The BPA, therefore, with our head start, can be helpful in this respect. We should not be ignored.

Second, as this director emerges, he will need a specialized association for the intercommunication of ideas with his fellow emergees. Will it not be better for the BPA to adapt itself to provide a ready-made grade of activity to attract such men than to have them orbitting aimlessly until they have grown numerous enough for mutual gravitation?

The answer is yes, because, third, the heads of photographic departments and the photographers producing the future aids are going to be working for these directors. Many of the latter won't even be able to take a picture or know anything about the techniques of photography. The technical section of the BPA should be maintained to advise the director on technical capabilities, innovations, and limitations. This will be better than being *told* to do the impossible, to mention only one advantage.

Again, it will be to the benefit of the BPA to work out, in its own educational and other programs, many of the ways to satisfy both the technical and professional needs of scientific education. Otherwise, biological photographers may find conditions beyond their control imposed upon them by people relatively new in the field. On the other side, the science teachers may not be able to find efficient photographic help for their scientific needs unless these are understood and prepared for.

The three categories, association of interdepartment heads, and technicians open to BPA will not be easy to establish and maintain. Yet, it is entirely feasible because the mutual problems and rewards are those associated with academic fields of exactingly specialized routines and ethics. We should not be discouraged by finding ourselves unique and therefore not finding counterparts for guidance in our future course. The uniting of the second and third categories already has made the BPA a productive educational body. Our Association can maintain these gains by being alert to technical advances. But, in addition, it is now facing this greater challenge of preparing a workable program for an expanded cooperation with scientific educators. It must be searching as well as alert here.

In the future, it is inevitable that the specialized problems of the directors will result in new organizations. But this is no cause for discouragement. The BPA already has biologists and electron microscopists on its membership list and it is working out means for liaison with their respective societies.

Mutual cooperation toward advancement can improve the service function of the BPA to its grades of membership and to the users. And the importance of biological photography as an educational aid increases the importance of the Association that symbolizes it as a specialized field.

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THE GEORGE EASTMAN HOUSE

BEAUMONT NEWHALL, Curator

THE stately mansion which George Eastman built for his residence in Rochester today houses the most complete collection on the development of photography and moving pictures in existence. Opened in 1949 as a public educational institute, the George Eastman House serves as a living and lasting memorial to the man who brought photography to all.

The fifty-room building, still retains the warmth and character of a residence. Both the exterior and the interior have remained unchanged since the time it was built in 1905. The main building is used for the presentation of the historic collection of photographs. The large garage and stable buildings have been converted for the display of contemporary photography and the manufacturing of photographic materials. Between these buildings and joining them, a 550-seat theatre has been erected with a special exhibition gallery on its second floor. Moving pictures from the extensive collections deposited at the George Eastman House are shown to audiences every weekend and three nights a week.

The George Eastman House came into being as an educational institution through the generosity of the University of Rochester. The University gave the building which they had inherited from George Eastman, and the Eastman Kodak Company furnished funds for the transformation of the building into a public museum and for its maintenance. The House is independently administered by a Board of Trustees, and is chartered by the University of the State of New York as an educational institution.

Since its opening more than a million visitors have seen the George Eastman House and its displays. Its exhibitions have been so successful that several of them are now touring the country. Its Festival of Film Artistry, [illegible] the Rochester Medal of George Eastman to leading stars of the silent era of motion pictures, has brought national recognition to its work in the preservation of the motion picture past.

Your visit to the George Eastman House, [illegible] free every day except Monday, [illegible] 5, and on Sunday from [illegible] begins with the House itself — an architectural masterpiece of the Colonial Georgian style. The front hall and the adjacent room have been left unchanged. George Eastman's favorite sitting room, teak paneled and with a rich Oriental carpet, still contains the original furnishings. His library is filled with books. And in a large reception room are hung the paintings which he collected, by such great Masters as Frans Hals, Sir Joshua Reynold, Sir Henry Raeburn, Tintoretto, Van Dyck and Rembrandt.

You pass into the conservatory — a two-storied, arcaded room which is the center of the House. Here is the console of the organ which was so much a part of George Eastman's way of living. He had it played every day, and for his friends at evening recitals. The tradition remains: every Sunday afternoon a program or organ music is offered the [illegible].

The photographic exhibition begins in the conservatory where, in specially designed glass cases are shown the beginnings of photography. Here are to be found rare treasures: a camera signed by Daguerre, a view of Boston taken in 1840 with an exposure of 40 minutes, relics of the Englishman, William Henry Fox Talbot, who independently of Daguerre invented the process which is the basis of [illegible]. The display continues through the wet plate period, where original negatives signed "Brady" are shown with the apparatus which produced them, into the comparatively modern era of the dry plate.

At this point George Eastman entered the history of photography and revolutionized picture making. The paneled dining room is entirely devoted to documents of his life, from a tintype taken when he was a baby [illegible] over the world which he built from his own pocket. Every step in his photographic career [illegible] is itemized: his first photographic purchases in 1877; his own film experiments of 1884; the first Kodak camera of 1888 with samples of the pictures it took; and some of Eastman's photographs of his camping trips, his friends [illegible].

On the second floor there are displays of a more specialized character: the wonder of stereoscopic photography; the growth of the amateur camera — with a full size diorama of amateur photography in the pre-Eastman days when a man had to take a completely fitted darkroom with him wherever he went; and the principles of color photography. Visitor-operated apparatus allows you to perform laboratory experiments and see the effect of colors and how they are recorded. The last galleries on the second floor are devoted to the moving pictures and military photography. The earliest motion picture cameras and projectors are on view, from the days of Lumiere and Edison, and these machines are arranged so you can see them operate. A part of the extensive collection of aerial cameras deposited by the U. S. Department of Defense forms the nucleus of the military display.

Ascending stairs, the visitor finds himself in the large Dryden Gallery where pictures are displayed. Here the work of photographers from all over the world is brought to Rochester. In this constantly rotating exhibition, schedule, photographs from the permanent collection of Eastman House are frequently shown.

Downstairs, to the rear of the House, are exhibits showing the manifold uses of photography in everyday life: How, with photography, scientists investigate the behavior of the atom, engineers study stresses, physicians the hidden parts of the body, law enforcement officers falsifications of documents. A special gallery is devoted to the manufacture of photographic materials, with actual machines for making lenses, film, plates and sensitized paper.

The climax of the visitor's tour is the Cavalcade of Color, a dramatic 16 minute showing of more than seven hundred color slides thrown on a 9 x 44 foot screen by automatic projectors, up to seven at a time.

Shortly after the Eastman House was opened to the public, Mr. and Mrs. George B. Dryden (George Eastman's niece) presented a 550-seat theatre. Here moving pictures of the past, collected by the House, are shown to audiences. Photographic groups use the Dryden Theatre for meetings and demonstrations. And in 1954, on the occasion of the 100th anniversary of his birth, the house where George Eastman was born was moved from Waterville, New York, to the grounds which he loved so well during the last years of his life. Furnished in the period of the 1850's, the birthplace is a striking example of the Greek Revival style of architecture, and is open to visitors.

BOOK REVIEWS

OPTICS THE SCIENCE OF VISION, *Vasco Ronchi, Translated by E. Rosen, New York University Press, ix + 360 pages, 6 in. x 9 in., illustrated, (1957), cloth bound, $10.00.*

Ronchi has written a personal book, rather than a textbook, to explain how he has been able to integrate the field of optics. Edward Rosen has revised and translated it into very readable English. Waves, rays, quanta, geometrical and physical optics need not be opposed. From their development over three centuries he assembles the fundamentals of vision as the essence of optics, considers vision by means of optical systems, the acuity of vision and the optical image. An appendix on the elements of wave motion includes notes on the kinetics and dynamics of oscillators motion, wave propagation, reflection, refraction and diffraction of waves. The central nervous system aspects of vision are emphasized, e.g., Ronchi uses the term *effigy* in place of the usual *image*, for the seen, real image from a lens. Point sources, resolution and acuity are defined in a helpful manner and the reviewer looks forward to Ronchi's final solution of the problem of the resolution of extended objects, when he adds the fifth decade to his optical integration. There is no instruction here on lens design, instrumentation, or application to technology; rather, the wisdom of an elder statesman who can write

[illegible] should interest those concerned with how we see and the use of optical instruments. O.W.R.

PRINCIPLES OF IMMUNOLOGY, *John E. Cushing and Dan H. Campbell, McGraw-Hill Book Co., New York, ix + 344 pages, 6 in. x 9 in., illustrated, (1957), cloth bound $6.50.*

The first section provides a general survey of the fundamental principles involved in immunology, describes the blood, chemicals concerned, and the general nature of active and passive immunization. The second section on biological immunology discusses antibodies, antigens, their relation to genetics and distribution in populations, development, mechanics, and closes with a chapter on comparative immunology. The details of antigens, antibodies, and their reactions comprise the third section of the book. The last part of this section gives a picture of the present status of knowledge in this field and its evaluation. There is an index and selected references following each chapter. The authors wrote it for college seniors majoring in biology, but much of it will have appeal to a broader audience, especially the first and last chapters. The problems of blood groups, vaccination, serological reactions can be read for general information or to give considerable detailed knowledge. The illustrations are clear, suggestive and show much progress since the former lock-and-key analogy. O.W.R.

COMPARATIVE ANATOMY OF THE EYE, *Jack H. Prince, Charles C Thomas Publisher, Springfield, Illinois, 418 pages, 6 in. x 9 in., illustrated, (1956), cloth bound $8.50.*

This is a biological book in which illustration is used to real advantage, from diagrams and sketches to photographs and photomicrographs, that could be studied by biological photographers and some authors as an example of the possibilities for illustration. Of course, comparative anatomy is primarily descriptive and one would expect pictures to save wordage. However, consider Figure 92 where a balloon and one and two pairs of hands depict mechanisms of muscle action and specialized reinforcing materials, to clarify how certain animals focus the lens in their eyes. In general, labeling is clear, although [illegible] of the figures it is difficult to follow all of the many lines from a single legend. How to point out similar, corresponding structures in several sketches on one plate needs further study and improvement. The details [illegible] of the photographs are good, although in the review copy, some of the halftones were too gray.

Prince brings together the information about the eyes of all kinds of animals in chapters on the orbit and eye positions, retina, special receptors, fovea and macula, fundus patterns, optic nerve and chiasma, visual centers, nictitating membrane and eyelids, spectacle or brille, cornea, iris, pupil, lens, accommodation, choroid and sclera, tapeta, pecten, scleral ossicles, eye size and shape, muscle, glands, filters, pineal and parietal eyes, and invertebrate eyes. A chapter, comparative ocular dissection, tells how to remove eyes for study and gives material on preparation and staining.

There is a bibliography, a glossary of animal names and an index. Critical comment is not spared in the text and need for further information is often stressed. As other books cover the human eye in detail, Prince mentions it only as he finds appropriate. The writing is clear, except that the abundant use of italics gets tiresome and probably defeats its intended purpose. The beginner, or non-specialist, should find the means used by animals to see under widely different conditions of life fascinating and the specialist will welcome another sourcebook in this field. O.W.R.

THE HUMAN FIGURE IN MOTION, *Eadweard Muybridge, Dover Publications, (New York), xvii pages, 195 plates, (1955), $10.00.*

During the last quarter of the 19th century Muybridge advanced biological photography by making successive pictures of humans and animals, with a battery of cameras, for the study of their movements. For many of the pictures grid backgrounds provide a basis for measurement in time and motion study from the pre-motion picture days. (See *B.P.A. Journal*, 1933, 2:39-56). As many as 24 cameras were used and the shutters were activated by mechanical and electrical means. The pictures were mounted in sequence on plates, many of which contained three rows of twelve pictures showing simultaneous side, front and back views of the subject. Some 780 plates were published, and this book re-

prints 195 plates selected from the eleven volume 'Animal Locomotion' of 1887. Robert Taft has written a brief introduction and provided a useful critical reference list. The plates selected by Mr. Domonkos and Dr. Green provide a comprehensive graphic of Muybridge's prodigious work. Despite several publications and not a few republications by others the original volumes of plates are scarce and rarely obtainable.

It is a tribute to biological photography that there is a demand today for these plates, and artists, biologists and physicians will be grateful to Dover for this reprint. Unfortunately the Dover reprints are grayish and appear somewhat washed out as compared with the same plates in the 1887 edition. The figures, nude or partially draped, illustrate walking, running, sports, trades and ordinary activities of men, women and children.

O.W.R.

MODERN METHODS OF MICROSCOPY, *Edited by A. E. J. Vickers, Butterworths Scientific Publications (London), Interscience Publishers Inc., New York, 114 pages, illustrated, (1956), $3.50.*

This book consists of reprinted papers from the British periodical *Research*. The editor introduces the series with a summary, Modern Microscopy, and closes with a chapter, Polarizing Microscopy in Organic Chemistry and Biology. The other chapters are: Cosslett, Recent Developments in Electron Microscopy; Horn, Development of Reflecting Microscopes; Roe, Applications of the Reflecting Microscopes; King, Fluorescence Microscopy; Wallis, Numerical Values and Quantitative Determinations; Perry, Surface Microinterferometry; Mott, Metallurgical Aspects of Microscopy; Barer, Phase Contrast Microscopy; Smith, Microscopic Interferometry; Causley and Young, Flying Spot Microscope; and Nixon, X-ray Microscopy. The chapters define the method, discuss the instruments and how they are used, current results obtained with them, and are illustrated with drawings and photomicrographs. Perhaps the most useful part is the selected list of references which terminates each paper. The articles are well written, brief summaries of microscopy in Great Britain during 1956 and include most of the advances in microscopy throughout the world. Smith's article includes much new material that is not readily available elsewhere. Anyone interested in microscopy will find reading this book a quick and easy way for finding out what is going on in this active and expanding field. O.W.R.

DICTIONARY OF MICROBIOLOGY, *Morris B. Jacobs, Maurice J. Gerstein and William G. Walter, D. Van Nostrand Co., New York, (1957), 276 pages, 6 in. x 9 in., cloth bound, $6.75.*

Some five thousand entries will answer many direct questions on bacteria, some other microorganisms, methods concerning identification, culture and life habits, diseases caused and commercial use of these organisms. Many of the definitions are quite elementary and some are inadequate. For example a phase microscope is stated to have an annulus in the condenser, which fails to exclude some dark field condensers and the essential diffraction plate in the objective is not mentioned. Not all definitions are consistent, e.g., "Microscopic. Capable of being seen with the aid of a microscope. The lower limit is about 0.1 micron", yet under Microscope, electron, is found "The resolving power is about 10A." (0.1u = 1000A). Why not give definitive definitions rather than general ones by stating, for example, that the logarithmic death phase is the period when the specific (relative) death rate is constant, rather than, "The period in which bacteria are dying at a rapid rate." Rapid does not define logarithmic, although logarithmic may be considered rapid even though it is not the rapidist possible. Photographers will be amused by "Photogenic. Bacteria that live in the sea and oceans. They produce phosphorescence." Turning to phosphorescence we find this dictionary says it is visible light generated by some organisms. Light is not defined except as it is polarized or monochromatic. "Visible light" is redundant, because there is no invisible light, since ". . . light is radiant energy evaluated according to its capacity to produce visual sensation." (American Standard, ASA Z7.1-1942). Writing a dictionary is admittedly a difficult task, but it also includes an obligation to make it correct. It would seem reasonable to use definitions from the standardizing bodies and technical societies when they are available and appropriate.

The more biological definitions seem to be better. Despite the criticism of this review, the book is well worth having and photographic departments should not wait for the next improved edition for their questions arising from biological and medical tasks that can be answered by this volume. O.W.R.

Your Association

A section of the Journal devoted to official announcements, chapter events, and other matters of historical significance to the Association.

President's Page

The important technical phases of biological photography have come in for well-merited attention at this Meeting. But the Program would be one-sided if we did not study also the applicational aspects. This session tonight is therefore devoted to an exploration into some of the ways to make the most efficient use of photographs in imparting biological information, particularly in the educational provinces. And we shall examine some of the subjects along technical and administrative lines that ought to be taught the progressive future BPA Member.

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The science of "visual education" is outgrowing its label. It never has supplanted auditory teaching -but certainly has nobly supplemented it. Then, too, there is the value of the directed tactile and proprio-perceptive experiences of manual practice that enter into many efficient training processes. And, the senses of smell and taste, which now have a rather limited application in the teaching of chemists and would-be brides, may represent a relatively untapped potential. For example, a waft of new-mown hay in an urban schoolroom or a whiff of smog in a rural counterpart could be quite educational!

This is a bit far-fetched but it emphasizes the need for a new label to indicate a "pan-stimulus education" for utilizing all portals to the intellect. There is already an appraisal of teaching "aids" of all kinds going on. This is calling for a particular kind of professional outlook that has just begun to come to a focus -in some fields more clearly than in others. Neither its origin nor direction is sharply defined however, in the biological and medical fields. There is better definition in the undergraduate schools than in the graduate courses. Yet "aberrations" are still the subject of attention from "course designers."

To bring this matter of the teaching aids coordinator or director closely home to the BPA darkrooms, we can appreciate that photography is going to play an indispensable part in the preparation of the major teaching aids -those of a visual nature. We are then entitled to ask the following question: Is this new "director" of such programs going to arise out of the biological photographic field, out of biological and medical scientific circles, or out of colleges of education?

Before we attempt to discuss a possible BPA answer, we can narrow down the consideration even more and ask this: Is the medical photographer going to tell the medical instructor when and how to use photography? Obviously

Presented at the 26th Annual Meeting, Rochester, N. Y.

only a rather special and rare kind of photographer is going to do that. Valuable suggestions on photographic aids can be given by photographers but they are hardly trained to supervise educational methods.

It all reduces to the fact that photography as a skilled biological *technique alone* is hardly a profession. It is in the degree to which the technician influences the *effective use* of photography that he becomes a "professional man." And it is only by somehow acquiring a professional status from formal training in education or from equivalent experience that a photographer can become the type of educator we are discussing and can direct a phase of professional activity for other professional men. As Tom Jones pointed out in his valuable paper before this meeting last year*, the term: "biological photographer," needs enlarging. That is true, but I would add that the image must lay in focus.

It is clear that not all biological photographers are educated for such positions or even want to take on such responsibilities. Scientific photography is a satisfying art in itself. There is a great need for additional proficient photographic technicians and department heads to *make* the photographs for our new director.

These photographers will furnish a steady progress in the efficient, conservative use of photography, because revolutionary methods are not going to be adopted over night. Such progress, worked out, written up and disseminated by the BPA, can well raise the over-all average of photographic utilization. The character of our Journal is flexible enough to bring biological and medical illustration to biologists and physicians as well as to photographers.

BPA how-to-do-it and how-to-use-it experience will also serve as a guide for those institutions that will not be in a position to inaugurate full and elaborate systems for propagating photographic aids. For example, most progressive general hospitals, while not associated with medical colleges, are offering formal postgraduate instruction to interns in addition to training programs for nurses and orderlies. They have directors of education who will want to operate as efficiently as possible in their particular educational efforts. These programs deserve as good photography as any other. Therefore, the BPA, in considering its educational program, need not feel that it should essay to make all its members *educational* experts—there is still going to be room for *photographic* experts familiar with the major technical, and applicational aspects of photography.

An impending teaching load makes important increases in efficiency inevitable. The BPA should be cognizant of the trends, because it will be affected in three major ways. First, many of our members do have the background, ability, and desire to grow into these educational advisory and directive offices. They are already performing some of the professional duties envisioned here. They will want to advance to meet the growing need. This is especially important, since the scientific circles and medical colleges have not yet themselves produced the particular directors that seem to be called for. The BPA, therefore, with our head start, can be helpful in many respects. We should not be ignored.

Second, as this director emerges, he will need a specialized association in his field for the intercommunication of ideas on the effective utilization and production of photographic aids in science with

* Jones, Tom: The Role of the Photographer in Medical Education, Jour. BPA, Vol. 23 No. 4, Nov., 1954.

his fellow emergees. Other groups will have something to offer along the lines of education theory, but where will he turn for photographic particulars. Will it not be better for the BPA to adapt itself to provide a ready-made grade of activity to attract such men than to have them orbitting aimlessly until they have grown numerous enough for mutual gravitation?

The answer is yes, because, third, the heads of photographic departments and the photographers producing the future aids are going to be working for these directors. Many of the latter won't even be able to take a picture or know anything about the techniques of photography. The technical section of the BPA should be on hand to *advise the advisers* on technical capabilities, innovations, and limitations. This will be better than being *told* to do the impossible, to mention only one advantage.

Again, it will be to the benefit of the BPA to work out, in its own educational and other programs, many of the ways to satisfy both the technical and professional photographic needs of scientific education. Above all, the BPA members must do all they can to raise the prestige and essentiality of biological photography. Otherwise, biological photographers may find conditions beyond their control imposed upon them from two sources — non-progressive reactionaries and, ironically, progressive people relatively new in the field. Benefits of progress in communication will be mutual because the science teachers will be able to find efficient photographers for their educational requirements when the needs are understood and prepared for.

The three-category association of directors, department heads, and technicians open to BPA will not be easy to establish and maintain. Yet, it is entirely feasible because the mutual problems and rewards are those associated with academic fields of exactingly specialized routines and ethics. We should not be discouraged by finding ourselves unique and therefore not finding counterparts for guidance in our future course. The uniting of the second and third categories already has made the BPA a productive educational body. Our Association can maintain these gains by being alert to technical advances. But, in addition, it is now facing this greater challenge of preparing a workable program for an expanded cooperation with scientific educators. It must be searching as well as alert here.

In the future, it is inevitable that the specialized problems of the directors will result in new organizations. But this is no cause for discouragement, because they need not be in opposition to our aims and interests. The BPA already has biologists and electron microscopists on its membership list and it is working out means for liaison with their respective societies.

Mutual cooperation toward advancement can improve the service function of the BPA to its grades of membership and to the users. And the growth in importance of biological photography as an educational aid increases the importance of the association that symbolizes it as a specialized field.

H. Lyle Clifford

CHAPTER NEWS

February 1, 1956 to June 30, 1956

I. B. Brown, Chairman

Boston: On February 28 at the Harvard School of Dental Medicine, Dr. Reidar F. Sognnaes took the group on "A Scientific Expedition to the Loneliest Island in the World." This was a fascinating illustrated account of a trip to Inaccessible Island. Mr. Stanley Cohen of Polaroid demonstrated the new high speed Polaroid film. Coffee and doughnut holes were served.

The March meeting was held at the Graduate Biology Laboratory of Boston University. Dr. Brenton R. Lutz showed a film and gave a demonstration of the setup used to photograph living blood vessels. The path of individual cells could be followed under normal conditions and under the influence of various drugs.

The final meeting of the season was held the end of May. The active members were given a dinner, courtesy of the Boston Chapter, and 18 hungry photographers took advantage of this. After dinner the Sturgis-Grant film on Myasthenia Gravis was shown. There was a general discussion of certification and plans were made for a chapter exhibit in Rochester.

So. California: The February meeting was held at the Los Angeles County Museum and featured Mr. Nicholas Bolintine, a medical photographer, artist, and bullfighter. This versatile gentleman presented a program entitled "A Touch of Mexico."

In March the meeting was at the L. A. County Hospital and offered a "double take program" consisting of color TV and a trip through the photographic lab. with Lloyd Matlovsky as host.

The April meeting was a "Progressive Photographic Party" with visits to Jason Hailey and Dale Healy, advertising and illustrative photographers, and to the Gibbons Color Processing Laboratory. The Southern California "swap board" seems to be flourishing — this sounds like a good idea for all of us who have things we don't need and need things we don't have.

A photographic workshop "carnival" was held in May at the L.A. County Museum. A new light modulator for shadowless normal and macro-photography, and a close-up motion picture camera rig were demonstrated by Lloyd Matlovsky. Maury Mills talked about the inaccuracies of flash synchronization and the "guesswork" in photoelectric exposure meters. Tom Masterson showed a compact 3-position almost automatic specimen camera. Louis Athon, museum photographer, demonstrated photographic reproduction of paintings.

The June meeting was a session on filing systems — something I bet we could all improve with benefit.

Capitol: The February meeting was held at the Armed Forces Institute of Pathology where Willis John Wood spoke on photomicrography. Mr. Wood's talk covered a brief history of micro-illustration and a detailed discussion of apparatus and techniques used. There was also a symposium on "The New Anscochrome Color Film" with Leonard Pimental as moderator.

In March Lt. Dittmann discussed color television in medicine at the Walter Reed Research Institute. Mr. Edward Garlock described the Donaldson Stereo-Camera.

The April meeting was also at Walter Reed and Mr. John Kane of Ansco discussed various Ansco products as regards speed, color fidelity, etc. Mr. Walter Harders explained the type of prints and transparencies needed for good printed reproduction.

In May Charles Brownell of Eastman Kodak discussed all phases of x-ray reproduction.

The June meeting was held at Johns Hopkins Hospital in Baltimore. Dwin Craig talked about "LogEtronics" or the application of electronics to photographic reproduction.

Chicago: On February 1 the Chicago Chapter was on Channel 11 TV. The program was moderated by Ralph Creer, assisted by Maria Ikenberg, Charles Lindsay and Leslie Hier. There was a demonstration of clinical photographic equipment.

The regular February meeting was held at the University of Illinois College of Medicine and featured a new movie called "Medical Education and the Motion Picture", produced by the A.M.A. The annual business meeting followed and officers were elected.

President:	Maria Ikenberg
Vice-Pres.:	Lou Pedigo
Secretary:	Dorothy Pinkham
Treasurer:	Charles Lindsay
Directors:	Attlee Tracy, Leonard Hart, Leslie Hier, Jr.

In March Mr. Wolfgang Zieler discussed "Basic Facts and Latest Advances in Microscopy with Emphasis on Photography"

The April meeting featured Mr. Edward [illegible] of Eastman Kodak who talked on "Recent Developments in Kodak Color Materials."

Dr. Stone, Vice-President of the Clayton Chemical Co. was guest speaker in May. He discussed high speed and fine grain developers. There was a question and answer period after the lecture. Mr. Bill Clifford shared honors by giving an illustrated lecture on correlating film speeds and developers.

The June meeting was held during the A.M.A. Convention in Chicago. Mr. William A. Osborne, art director at the Saunders Co. in Philadelphia talked on "Use of Illustrations in Scientific Publications".

Houston: On February 4 there was an afternoon meeting at the University of Texas. After the business session there were four scientific papers and then a motion picture [illegible] Robert A. Kolvoord discussed the [illegible] "Narrow Band Light Sources in Photomicrography". Gene Davis demonstrated the Arriflex camera, and R. M. Christopher showed the use of Art Type in motion picture titles.

The Annual Meeting of the Houston Chapter was scheduled for May 5.

Indiana, Central: The February meeting was held at Indiana University Medical Center. Two films were shown "Behind Your Snapshot" and "Quality in Photographic [illegible]". There was a discussion period at the end and it was decided to set aside time at the end of each meeting for a discussion of basic photographic techniques.

In March Mr. Edward Sims spoke to the group on "Maintenance of Equipment and Trouble Shooting". There was a general discussion of printing errors, defecto and print quality. Mr. Lund [illegible] of the Eisler Co. told the group about several new products. An Eastman Kodak movie was shown - "Control in Photographic Papers".

The April meeting centered on motion pictures and magnetic sound. Dr. Wayne Carson spoke about the need for good surgical films in teaching and showed one titled "Carcinoma of the Lung".

In May George Cave discussed the two week color course he recently completed at Ansco. He covered the making of color film, principles of light and color, absorption of various layers of film, the new Printon and filter balance. Robert Albright gave an illustrated lecture on a new device for duplicating color transparencies.

The June meeting was devoted to Ansco color processing.

Upper Midwest: The Mid-Winter Meeting was held at the V.A. Hospital in Iowa City. There were four scientific papers given at the afternoon session which included a time lapse movie on "Cinematography and Cell Physiology" by Dr. Linefelder of the Department of Ophthalmology, "Graphic Arts in a Medical Teaching Institution" by Mary Arp of the Department of Medical Illustration, "Effects of Filters on Black and White Photomicrography" by Louis Nichols of the Mayo Clinic and a discussion of medical movie techniques by Jack Davis. On Sunday morning there was a session on eye photography and a report of experience with the new Eastman Color Print Process.

The Spring Meeting was held in May at the Mayo Clinic. There was a print panel with Verlin Yamamoto and Stanley McComb and three papers: "Masking Color Transparencies for Color Duplication" by Lorin Leibgeber of Eastman Kodak, "Preparation of Material for TV" by Louis Facto of Iowa State College, and "Making Surgical Motion Pictures" by Lardner Coffey of the Mayo Clinic. In the evening the Sturgis-Grant film "The Motion Picture in Medical Education" was shown. Sunday morning there was a discussion of Special Photographic Equipment, Methods and Gagets" in the Photographic Department of the Mayo Clinic.

There was a business meeting and the following officers were elected for the ensuing year:

President: Lardner Coffey
Vice-Pres.: Charles Deutch
Sec.-Treas.: Louis Nichols

Mr. Nichols is also the Executive Secretary of the 1957 Annual Meeting.

New York: The February Meeting was held at Cornell Medical College where David Lubin spoke on "A Single Step Method in Producing Radiograph Facsimiles". The process uses ordinary x-ray film and does not require the use of a dark room.

In March Paul Cherney, an expert on the subject of underwater photography, showed

an extraordinary color film "Exploring Secrets of the Underwater World". The film was made by Dimitri Rebikoff, co-author with Paul Cherney of the book "A Guide to Underwater Photography". The unusual film shows the true colors of the sea bottom even at [illegible] feet.

Mr. John Weber was guest speaker in April. His subject was "Light Sources in Medical Photography". The talk included a discussion of all light sources with emphasis on light with the new color films. There was a business meeting and election of officers. The following people will serve for the new term:

Chairman — Nathan Kantor
Vice-Ch — Lester Bergman
Secretary — Constance Holland
Treasurer — Stanley Simmons
Director — Lillian Lesser, Sidney Shapiro, Percy Brook, Warren Sturgis

In May Mr. Fritz Goro of Life Magazine was guest speaker. Mr. Goro has designed special equipment for close-up work and has recently returned from an expedition to the Antarctic.

Prairie: Mr. Johnson who is the Vice-Chairman of the Prairie Chapter presided at the February meeting. Bob Crocker gave an illustrated lecture on art and design. Two films were shown: "Design-Line" and "Design-Composition".

St. Lawrence Valley: The February meeting was held at the Montreal Neurological Institute and the subject for the evening was photomicrography. Dr. Olszewski spoke about [illegible] tains, John Linder discussed theory and practice, Harold Green interpreted. This was an ambitious undertaking and must have been very rewarding for all present.

In March Jacques Renaud and Charles Hodge presented a talk on "Operating Room Photography".

At the fifth meeting in April Harry L. Parker, President of American Speedlight Corp., was the principal speaker. He discussed electronic flash in scientific photography.

The sixth meeting was held at the University of Montreal in May. Maurice Constant of the National Film Board spoke on "Time-Lapse Photography".

The June meeting was a "Get-Together Night" at the Montreal Neurological Institute. A film on embryology illustrating the use of macrophotomicrographic and time-lapse techniques was shown.

CHAPTERS COMMITTEE

A meeting of the Chapters Committee was held on August 30, 1956 in conjunction with the 26th Annual Meeting of the Biological Photographic Association.

Thirteen of seventeen chapters were represented. Arkansas, Rochester, St. Lawrence Valley and West Virginia did not have representatives at the meeting.

All present agreed that more rapport was needed between chapters and the National Association and felt that this meeting was a step in the right direction.

Exhibits — the Boston Chapter entered an exhibit of twelve 11 x 14 black and white prints as a cross section of what the members were doing along those lines. This exhibit was not entered competitively and members contributing were still eligible to exhibit prints in the regular competition. The idea was well received and other chapters will probably have similar exhibits next year.

Membership — the chapters would like to have some literature which they could use to stimulate membership. They feel that this should come from headquarters. Many claim that they are unable to secure membership blanks.

Journal — the chapters agree that there are many papers given at local meetings that would be good material for the Journal. In order to see that some of these papers get to the Journal it was suggested that a member of each chapter be appointed to take note of the papers given locally and make it his or her responsibility to get these manuscripts to the Editor.

Meeting notices — the secretary of each chapter should mail a notice of the local chapter meeting to secretaries of other chapters at the same time the regular notices are sent. In most cases this would bring the notice before the actual meeting had taken place and might make it possible to attend the meeting of another chapter. It also brings the chapters news while it is still news rather than several months later when it appears in the Journal News section.

Charters — the chapters voted to have a charter showing the date of acceptance of

their chapter. This charter could be displayed by the current chapter chairman and handed down to his or her successor.

News — the chapters would like a "news letter" to keep them up to date on National and other chapter news. They feel isolated from the major activities or the National Association

L. B. Brown, *Chairman*

NEW B.P.A. MEMBERS

(April through June, 1956)

Dirk C. Bloemendaal, Holland, Mich.
Miss Gertrude A. Catlin, Geneva, N.Y.
John A. Chew, New Brunswick, N.J.
J. V. Durden, Ottawa, Canada
Aron N. Feifer, Montreal, Canada
Earl Garside, M.D., Chicago, Ill.
Mohamed Azeez Hussain, Georgetown, British Guiana
Walter J. Hybiak, Chicago, Ill.
Ross Jackson, Ottawa, Canada
Clare W. Johnson, M.D., Phoenix, Ariz.
Paris C. Johnson, Bridgeport, Ind.
Harry Lynn Jones, Queens, Village, N.Y.
Walter S. Lentschner, New York, N.Y.
I. H. Mackintosh, Elon College, N.C.
Nihls B. Nihlsson, Stockholm, Sweden
David O'Meara, Old Town, Maine
K. George Ozaki, New York, N.Y.
James H. Peacock, Toronto, Canada
Vernyl D. Pederson, Brookings, S.D.
Jesus M. Quinones, M.D., Santurce, Puerto Rico
Bertram Selverstone, M.D., Cambridge, Mass.
John C. Shepard, Louisville, Ky.
Julio Simons, M.D., San Juan, Puerto Rico
Henry M. Spelman, III, West Palm Beach, Fla
Perry Staub, Zurich, Switzerland
Miss Viola Syring, Omaha, Neb
Oakleigh Thorne, II, Boulder, Colo
Miss Barbara Tucker, Edina, Minn
Maurice R. Wallace, Napa, Calif
Donald Wong, New York, N.Y

(July through Sept., 1956)

George Blair, Red Bank, N.J.
Sidney H. Cox, Franklin, Tenn.
H. L. Dean, Iowa City, Iowa
Josse E. deWever, Jersey City, N.J.
Hans Dommasch, Saskatoon, Canada
Robert C. Drews, M.D., St. Louis, Mo
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Susan H. Wilkes, White Bluff, Tenn
Edward D. Wilson, Wrightsville, Pa
Paul Zuckerman, Buffalo, N.Y.

LOUIS SCHMIDT AWARD, August 30, 1956

The man whom we are honoring tonight with the Louis Schmidt Award is at the height of an already long career in photography, which, fortunately for us, has been directed toward areas of medical interest.

He began his photographic career with a box camera while in high school. From there, he progressed through the stages of darkroom chore boy, assistant to a commercial operator, and eventually emerged as a full-fledged photographer. Many are the amusing stories he can tell of his innocent clumsiness. Among them is the accidental firing of a full charge of flash powder under a sprinkler system which resulted in his being transferred to another department. This was a lucky thing really, for it sent him on his way to a successful motion picture career.

But his path to success in motion pictures was not a smooth one either, for this brash young man seldom hesitated to try his hand at anything. Not infrequently he found he had laid claim to more territory than he could manage. Nevertheless, his inquisitive turn of mind and his inability to refuse any kind of

in assignment provided for him a richly rewarding experience in the motion picture field.

His background includes work with Pathé, Kalem Studios, Bell and Howell and [illegible]. At the outbreak of World War I he was on a roving assignment for Pathé [illegible] in Canada. During the course of the confused events of that time, he found himself assigned as a pilot instructor in aerial photography at Camp Borden in Toronto, where United States fliers were trained. Following the war, he remained in Toronto as a motion picture news photographer.

Sensing news in what Doctors Banting and Best were doing in Toronto, he traded photographs of Doctor Banting's rats for help with a news story. These were his first medical photographs. Soon thereafter, equipped with [illegible] arc light placed on the roof over the operating room skylight, and with stepladders and a hand-cranked motion picture camera in the [illegible], he made a film of a surgical procedure. This was his first, but by no means his best, medical motion picture.

About 1926, when talking pictures were getting under way, he [illegible] activities to the Bell and Howell Company in Chicago. Here he became one of those commercial representatives who helped so many motion picture laboratories to convert from hand to mechanized processing. During this time, he made a sound film on the subject of insulin for the Eli Lilly Company. It is safe to say that this is the first all-sound medical film.

He [illegible] to educate himself with less orthodoxy than most of us practice by selecting training when and where he thought he needed it. His academic wanderings have carried him to Pennington, Rutgers, London, Toronto, and Northwestern. The appropriateness of his academic choices is demonstrated in the fine medical films he has produced and in his publications, which include papers in our own Journal and in the Journal of the Society of Motion Picture and Television Engineers.

This remarkable man has been responsible for the first application of motion picture instrumentations which many of us now accept as a matter of course. Among his achievements in special devices is the ingenious cinéphotomicrographic apparatus now in use in his own laboratory. If specialized motion picture equipment is needed and cannot be found, this man will find a way to have it produced.

Never in his career has he even refused to help a fellow worker in need of assistance. His knowledge, ability, and energy have always been, and still are, at the disposal of others who need his help.

He has been an active and friendly participent in BPA affairs for over fifteen years. He has contributed to salons and to the Journal, has been on committees, and is now serving as a Director. At present he is guiding the Association through its complex insurance program.

Mervin LaRue, Fellow of the BPA, one of the most pleasant services I have been privileged to perform for the BPA is to present this citation and this jeweled key to you in recognition by the Association for your outstanding performance in the field of medical motion pictures, your unselfish and active service to your fellows, and your loyal devotion to the Association.

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- Miniature Slide Attachment
- Arrow Projection Torch

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Members may propose for Fellowship in the BPA other members whom they consider worthy of recognition. To be eligible for Fellowship a candidate must have been a member of the Association for five consecutive years and must possess one or more of the following qualifications:

Superior craftsmanship in still or motion picture photography of biological subjects.

Ability in photographic research in new methods or materials.

(These require submission of evidence.)

Meritorious contributions to biological photography overall through sustained organizational work.

Two sponsors are required. The sponsors should be well acquainted with the candidate's work and ready to furnish the Board with details of his experience and achievements. Those who wish to sponsor a member whom they believe to be eligible should request a Fellowship Application form from the Secretary of the Fellowship Committee: Mrs. Maria Ikenberg, University of Illinois, 904 W. Adams Street, Chicago 7, Illinois.

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